ANCIENT MASONRY,

BOTH IN THE

THEORY and PRACTICE,

Demonſtrating the

USEFUL RULES

OF

Arithmetick, Geometry, and Architecture,

IN THE

PROPORTIONS and ORDERS of the Moſt
EMINENT MASTERS of All Nations,

VIZ.

VITRUVIUS,	P. CATANEO,
BRAMANTE,	P. DE LORME,
JULIO ROMANO,	VIOLA,
MICHAEL ANGELO,	J. BULLANT,
CARLO CESARE OSIO,	JULIAN MAU-CLERC,
ANDREA PALLADIO,	J. BERAIN,
VINCENT SCAMOZZI,	SEBASTIAN LE CLERC,
M. J. BAROZZIO of VIGNOLA,	CLAUDE PERAULT,
SEBASTIAN SERLIO,	INIGO JONES,
DANIEL BARBARO,	SIR CHRISTOPH. WREN,
L. B. ALBERTI,	&c. &c. &c.

And alſo of the

CARIATIDES, PERSIANS, FRENCH, SPANISH, and ENGLISH.

Together with Their

MOST VALUABLE DESIGNS

FOR

TEMPLES,	GATES and DOORS,	TROPHIES,	PAVEMENTS,
TRIUMPHAL ARCHES,	WINDOWS,	BALLUSTERS,	ARCHES,
PORTICO'S,	NICHES,	BALCONIES,	GROINS,
COLONADES,	ENTABLATURES,	BALLUSTRADES,	STAIR-CASES,
PIAZZA'S,	PEDIMENTS,	CIELING-PIECES,	ROOFS,
ARCADES,	CAPITALS,	CHIMNEY-PIECES,	OBELISQUES,
FRONTISPIECES,	FESTOONS,	FLOORS,	ORNAMENTS, &c.

The Whole interſperſed with

CRITICAL REMARKS and OBSERVATIONS on each MASTER,

Illuſtrated by above

Three Thouſand EXAMPLES, Engraved on *Four Hundred* and *Ninety four*
large Folio COPPER PLATES.

WITH A

DICTIONARIAL INDEX, explaining the TERMS of ART uſed herein.

By B. LANGLEY.

LONDON:

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MDCCXXXVI.

TO

His Royal Highness *Francis* Duke of *Loraine*,

The Most Noble
- *Charles* Duke of *Richmond*, G. M. Anno 1725;
- *Charles* Duke of *Marlbrough*,
- *Francis* Duke of *Buccleuch*, G. M. Anno 1724,
- *James* Duke of *Athol*,
- *John* Duke of *Montagu*, G. M. Anno 1722,
- *Charles* Duke of *Queensberry* and *Dover*,
- *Thomas* Duke of *Newcastle*,

The Right Honourable

Henry Earl of *Pembroke*,
Daniel Earl of *Winchelsea* and *Nottingham*,
Philip Earl of *Chesterfield*,
William Earl of *Essex*,
William Earl of *Albemarle*,
John Earl of *Craufurd*, G. M. Anno 1734,
John Earl of *Loudoun*, G. M. Anno 1736,
Thomas Earl of *Strathmore*,
William Earl of *Inchiquin*, G. M. Anno 1727,
Alexander Earl of *Hume*,
William Earl of *Kellmarnock*,
James Earl of *Wemys*,
Charles Earl of *Portmore*,
James Earl of *Abercorne*, G. M. Anno 1726,
Earl of *Ankram*,
Earl of *Horne*,
Anthony Lord Viscount *Montagu*, G. M. Anno 1732,
Thomas Lord Viscount *Weymouth*, G. M. Anno 1735,
Simon Lord Viscount *Harcourt*,
John Lord Viscount *Tyrconnel*,
Lord Viscount *Erskine*,
Lord Viscount *Vane*,
Lord Viscount *Bruce*,
George Lord *Carpenter*,
John Lord *Delawar*,
Thomas Lord *Lovel*, G. M. Anno 1731,
Thomas Lord *Southwell*,
Henry Lord *Colerane*, G. M. Anno 1728,
James Lord *Kingstone*, of *Ireland*, G. M. Anno 1729,
Charles Lord *Cathcart*,
Lord *Carmichael*,
John Lord *Hobard*,
Lord *Belhaven*,

And to all others The Right Honourable and Right Worshipful MASTERS of MASONRY.

My Lords and Brethren,

THE *Principles* and *Practice* of ANCIENT MASONRY, being the Subject of the following Sheets, to whom can I so justly inscribe them, as to Your *Most Noble, Right Honourable*, and *Right Worshipful Selves*; not only with regard to your being MASTERS thereof, but to your great Encourage-

ragement given, and *Honour* done to the ART, as well as your most affectionate Respect manifested to every *Brother* of the Fraternity, an illustrious Example to all other Nations.

THE false Conjectures of MASONRY, and its great Use in furnishing the *Fellow Craft*, and other *Artificers* in general, with the useful Rules, Proportions, and Examples of the most eminent *Architects*, that have lived in all Nations, have been not the only Motives of my compiling this Laborious, Extensive, and Most Useful Work: But as it is the Duty of every Man to communicate such Knowledge as he is bless'd with, that will be of service to the Publick, I therefore thought *this* my Duty; and which, being happy under your *Lordships Protections*, cannot fail of a kind Reception among the good-natur'd and judicious Part of Mankind.

THE Industry, Care, and Pains that I have taken herein, for the Service of my Country, *your Lordships* will readily perceive; and that the censorious Part of Mankind may thereby not only learn the Principles of this MOST NOBLE ART, but how to correct their Mistakes for the future.

THAT your Lordships may long continue the Encouragers of *Arts* and *Sciences*, is the sincere Prayer of

My LORDS,

Your Most Obedient,

Humble Servant, and

Affectionate Brother,

B. LANGLEY.

THE

THE

INTRODUCTION.

By X—— X——.

THE Number of Books daily publiſh'd on *Architecture*, and the little Uſe they are of to Workmen in their Practice, for want of a juſt Knowledge of thoſe Sciences on which Architecture immediately depend, gives ſo ſenſible an Idea of the Advantage a Work of the following Nature would be to all concerned in Building, that a SOCIETY (who daily *experience* and *practiſe* the ſeveral *Arts* which lead to a general Knowledge of *Architecture)* have concluded to demonſtrate the ſame, in a plain and eaſy manner, throughout all its various Parts, for the Uſe of Artificers in general.

AND, as every thing which is neceſſary to make *compleat Workmen*, and *good Architects*, will be carefully and ingeniouſly handled in the following Work, it will contain *more Knowledge* than all the other Books of Architecture.

AND for its Utility to thoſe concerned in Building, as well as other Employments, we hope nothing can be more advantageous; becauſe every Branch ſhall be carefully and methodically handled, and every Page will be perus'd and modell'd by the whole *Society*. And as ſo voluminous a Work is the Labour of a SOCIETY, it will contain the Knowledge of many, and more particularly ſuch who daily experience the Advantages of it in the ſeveral Parts of Building.

VITRUVIUS reckons no leſs than Twelve neceſſary Accompliſhments to make a compleat Architect, *viz.* 1. He muſt be *docil* and *ingenious*. 2. He muſt be *literate*. 3. *Skilful* in *deſigning* and *drawing*. 4. In *Geometry*. 5. *Opticks*. 6. *Arithmetick*. 7. *Hiſtory*. 8. *Philoſophy*. 9. *Muſick*. 10. *Medicine*. 11. *Law*. And 12. *Aſtrology*. But if the Law, Phyſick, and Aſtrology were left out, I think we ſhall treat of all the reſt, *Muſick not excepted*, which will appear by our *harmonick Proportions*.

IT would be of no Advantage to ſuch who are pleas'd to encourage this Work, if we were only to collect the Labours of other Men, and place them in our *Magazine of Architecture*, as many have done, and particularly ONE lately publiſhed under that Title, which is wholly compoſed of other Mens Works, that were before in different Books extant: therefore we deſign to offer nothing but what is entirely new, and of our own Production; or at leaſt handled in a manner ſo different, and ſo much more advantageous than what has been hitherto attempted, that every one will find his Expence ſufficiently compenſated.

WE are confident, that not only thoſe who practiſe the Art, but likewiſe Gentlemen may find an agreeable Amuſement in the Peruſal of this Undertaking, becauſe there is nothing in the OEconomy of Art, but in ſome meaſure will have a Place in it; there will be ſeveral agreeable and entertaining *Propoſitions* ſolv'd, as they occur in their Places, and *many uſeful Deſigns*, both in the *Plan* and *Elevation*, which will add much to the Advantage and Satisfaction of the Subſcribers.

AS nothing makes a Man more valuable than *Learning*, and thoſe Accompliſhments which are attendant on it; ſo on the other Hand, nothing appears ſo deſpis'd as the *Ignorant* and *Illiterate*, or at leaſt ought to be more pittied, for being depriv'd of the *happy Advantage* which others enjoy.

LEARNING, in all its Branches and Characters, may be properly ſaid to diſtinguiſh us from one another, as well as from the reſt of the Animal Creation, more diſtinctly than Speech: Birds acquire the Faculty of ſpeaking, but it is for the moſt part miſplaced; it is only the retaining Words and Accents, not knowing how to apply them: In ſhort, they may be compar'd to an Engine juſtly performing its Rotation, and not knowing its own Uſe: And thus it is with many Workmen, who by Habit and Cuſtom perform divers Operations, but know not the Cauſe or Reaſons thereof.

THE natural Embelliſhments of the Mind, by Converſation and Society cultivated and improved, and by a Propenſity to Knowledge rectified and regulated, ſoon acquires the Faculty of Learning; and in whatever Branch of Learning the Mind makes its Progreſs, it attains its deſired End.

LEARNING is a Jewel of ineſtimable Value, and *he* who is poſſeſſed of it, poſſeſſes all Things. The Goods of Fortune, by Multitudes of Caſualties, periſh and are deſtroy'd: Earthquakes, Innundations and Tempeſts ruin and impoveriſh many Countries; but *no Misfortunes ſhock the Soul of the Philoſopher*; in Proſperity and Adverſity he is ſtill the ſame; his Wiſdom, by making Excurſions into the Channels of Fortune, make every Stage of Life equal: *Knowledge* is acquired by *Study* and Aſſiduity, and by cultivating thoſe Seeds of Wiſdom which Nature has implanted in us. We ſhould look into ourſelves, but more particularly our Children, and endea-

vour

vour to diſcover which way Nature has intended to direct the Channel of their Genius; if to the *Mathematicks*, ſuch Branches of Learning which lead to thoſe ARTS, ſhould be carefully taught them, and not ſtop the Current by throwing in Lumber of *Law*, *Hiſtory*, &c. which are contrary to Nature's Deſign, and ruins the Artiſt: Nor muſt he who deſigns to be a *ſound Workman* or *Architect*, load his Mind with *Politicks*; he will find Matter enough herein, to employ his whole Study, to become Maſter thereof. No Art is ſo narrow and confin'd, but it will take up much Time to be acquainted with, and it's better to know one Thing well, than ſuperficially to know many. There are many Branches of Learning in every Art, and thoſe Paths which lead to them muſt be carefully trod; Circumſpection and Diligence are requir'd to finiſh all our Undertakings.

LEARNING is a Topick which leads us from one Labyrinth of Pleaſure to another; it is as extenſive as the Univerſe; it conſiſteth of infinite Diviſions; if we trace it from one Channel to another, it never loſes its Beauty; its Luſtre is always apparent; and whatever Shape you view it in, it always charms you. The *Votaries to Learning are very few*, and the giddy Multitude, blinded with fugacious Pleaſures and Follies, have not Good-nature enough to reſpect them. I cannot paſs over the Advantages Mankind have reaped by the Wiſdom and Unity of our *Royal Society*; they have planted Knowledge in the Minds of the Unknowing; they have cultivated the natural Genius of many: in ſhort, like *Orpheus* with his Lyre, they have made *Stocks* and *Stones attentive* to their Muſick.

As to the natural Genius, we ſee how many lively Inſtances of it have appear'd in the Hiſtory of all Ages. The *Man* in whom the Seeds of Knowledge are ſown, in ſpight of all the Obſtacles of Fortune, will be ſtill the ſame; the Ideas which Nature originally ſtamps on the Mind, cannot be worn out by Poverty, Want of Education, proper Opportunities in Societies, Books, Inſtruction, &c. I ſay, in ſpight of all theſe Impediments, the bright Ideas will ſhine; they will appear beautifully thro' all the little Clouds of Fortune, and, like the Sun-Beams on the Surface of the Water, reflect their benevolent Rays on the Eye of the Beholder. How happy is the Fate of that Man, whom Nature, in ſpight of all Obſtructions, has ſupply'd with beautiful Embelliſhments of the Mind, yet wants the nice Correction and Care of Art, to cultivate and improve them; to draw them gradually from the little Errors of ignorant and ill-digeſted Opinions, imbib'd in Minority, thro' the Want of a juſt and regular Education.

ACQUIRED KNOWLEDGE flows from the improving and refining the *natural Genius*. The Seeds of Learning, when firſt ſown, are like a little Embrio which gradually increaſes in every Degree of Time, 'till it hath attain'd its Maturity. It is firſt improv'd by proper Principles inſtill'd, ſuitable to the Nature of the Genius which is to be refin'd; it takes Root, and ſpreads itſelf ſlowly into Form, which, like a young Fruit-tree, by pruning and regularly diſpoſing, keeps from ſhooting into ſuperfluous Branches. As Thorns bring not forth Thiſtles, ſo no Art or Means can make *the Man who is naturally born a Mathematician*, to be otherwiſe; and the great Painter and Architect are ſo by Nature as well as Art; and probably there are many fine Men, now buried in Oblivion, who, if they had the Happineſs of a ROYAL *Encouragement*, might become *Newtons* in Philoſophy, *Raphaels* in Painting, and *Palladios* in Architecture.

Superficial Learning is a ſort of middle Path between *natural* and *acquired Knowledge*; it is as it were the Shell or a gilded Outſide without Value, a Shadow without Subſtance, a Multiplicity of Ideas without Order, a Medium between ſomething and nothing; in ſhort, a Body without a Soul: Such a one graſps at every thing, and can retain nothing; of which Mr. *Pope* finely obſerves,

One Science only, will one Genius fit;
So vaſt is Art, ſo narrow human Wit. Pope on Criticiſm.

I have thus far ventured to define *natural, acquired, and ſuperficial Knowledge.* I propoſe now to ſhew you the Uſes of Learning, as far as it relates to Mankind in general, and *Societies* in particular. In general it is ſubſervient to all, in all the Stages and Stations of Life: Our walking, ſitting, lying down, riſing, &c. are performed by *mechanick Powers*; and tho' the Ideot, the Illiterate, and Unthinking Part of Mankind, cannot diſcern it, yet every *Mathematician* can very evidently demonſtrate it; every Action is a mechanick Operation that is perform'd by the Laws of Mechaniſm. The Motion and ſudden Velocity of our Bodies, are the Effects of a Mathematical Power, and the Contemplation of it elevates us a Degree above the reſt of our Species.

Learning is neceſſary for the ſure Direction of Affairs in all Parts of human Life, but more particularly in making Laws, diſtributing Juſtice, Trade, Traffick, and Commerce; in diſcerning the Motion of the heavenly Bodies; in Weights, Meaſures, Travel; in ſhort, in every thing which concerns Society to be acquainted with. Without Reaſon and Wiſdom, Laws were not firſt form'd, modell'd, and deſign'd; nor could Juſtice be impartially diſtributed. Without Navigation and Geography, Traffick and Commerce could not be; nor could we judge of, nor deſcribe the Motion of the heavenly Bodies, without Aſtronomy; by Geometry, Weights, Meaſures, and the Power of Lines are preſerved; and indeed we find no one Branch of Learning but is uſeful in ſome Part or other of the OEconomy of human Nature.

Besides all this, the Pleaſures which the thinking Mind takes in a Purſuit after Knowledge, are inexpreſſible. The *Aſtronomer* can ſoar from one Planet to another, and from one Region to another, 'till the Mind is loſt in an *Eternity of Space.* The *Geographer* can travel from one Country to another, thro' the various *Climates* over *Sea* and *Land*, and encompaſs the whole Earth in his Imagination, and yet be only retired to his Cloſet, or contemplating in the Field. The *Painter* can ſee *Groups of Figures*, and *lively Landſkips*, to divert the Ideas of his Mind. The *Architect* raiſes in his Idea Numbers of pleaſing *Structures*, the *Orders* growing like tall Cedars, beautiful and proportioned, with a regular *Symmetry*, and juſt Exactneſs. The *Poet* repreſents to himſelf beautiful *Hills*, and *Lawns* of pleaſing Vallies and circling Rivulets, the Harmony of Numbers and Nature. The *Mechanick* ideally ſees Multitudes of various Machines for Conveyance of *Timber, Stone, Water*, &c. all perfect and pleaſing to his Imagination. The *Mathematician* has his *Globes, Triangles, Cubes, Priſms, Glaſſes* of *Reflection* and *Refraction, Lights, Colours, Shades*, &c. All theſe I ſay, by a little Expanſion of the Mind, are ſeen as natural, as the *Statuary* views in a Block of Marble, a *beautiful* Statue, which only requires his nice Hand to take away the groſs Particles that encloſe it, whereby others may view it with equal Pleaſure as himſelf.

I must

I MUST obſerve to you, as Buildings are requiſite for private Houſes, ſo publick Tranſactions require much Knowledge in the right Application of our Ideas: And to adapt them juſtly to the Wants and Conveniencies, is (tho' ſeldom regarded) what appears moſt requiſite in our Taſte and Executions. *Courts*, *Palaces*, *Seats* of *Pleaſures*, &c. ſhould be gay and airy; on the contrary, *Tribunals*, *Courts of Judicature*, *Temples*, &c. ſhould be grave and ſolemn, to ſtrike the Beholder with a majeſtick Awe of the Solidity and ſerious Purpoſes of the Deſign. *Seminaries* of *Literature* ſhould have a little more Vivacity and Gaity. Much Temper is required in Productions of this Kind, and much Study neceſſary, to know where to apply rightly the different Ideas intended to be executed.

A SEAT continually expoſed to the Violence of the extream Seaſons, or on a *Hill* unguarded by Woods, ſhould have a Mixture of Solidity and Gaity at the ſame Inſtant.

THE *Vallies* require more Chearfulneſs, while the ſhady Rivulet, with the encircling Warmth of chearful Greens, and all the Pleaſures of a rural Proſpect, ſhould be pleaſing and ſerious, adorn'd with *Sculptures* and *Feſtoons* of the various Products of the Seaſons, with an enlivening Variety and Regularity. The ſilent *Gloom of Woods*, and the *deſart* and unfrequented Places, among winding Meanders, and a ſhort bounded Proſpect, requires the moſt airy and beautiful Productions, mixing with the ſolemn *Gravity of Nature*, the moſt exalted *Beauties and Gaiety of Art*; ſuch are the different Products which different Situations require, and ſuch are the Neceſſities which ſhould induce us to apply ourſelves to the Study of a Science the moſt pleaſing and various that the Art of human Invention could produce thro' every Age ſince the Beginning of Time.

AS I believe it will be granted that the *Ancients* had this juſt Taſte of Building peculiar to themſelves, ſo our Endeavours ſhould be uſed for the attaining thoſe Rules of which the *Ancients* were poſſeſſed; whoſe Buildings, as well internal as external, ſo charm'd the Mind, and raviſh'd the Eye, that the *Architects* themſelves were, by the Vulgar, often thought to be *divinely inſpired*; when, in Fact, the *Beauty* and the *Pleaſure* their Works gave, were only the Effects of a *well-choſen Symmetry*, connected together according to the *harmonick Laws of Proportion*, which of neceſſity naturally produce that Effect upon the Mind thro' the Eye, as the Cords or Diſcords of Muſick, pleaſe or diſpleaſe the Soul thro' the Ear.

THEIR Decorum was always juſt in every Repreſentation, whether *ſerious*, *jovial*, or *charming*; for this End they eſtabliſhed a certain *Modus* to be obſerved in the Uſe and Application of the ſeveral Orders. The *Dorick* Order was always apply'd to Things *majeſtick*, *grave*, and *ſerious*, and call'd the *Dorian Modus*. The *Ionick* to riant Uſes, ſuch as to Temples of *Bacchus*, &c. call'd the *Ionick Modus*. The *Corinthian* Order was uſed in *Palaces*, *Triumphal Arches*, and *Houſes of Pleaſure*, and call'd the *Lydian Modus*. By theſe Rules they always kept Pace with Nature, and by a ſtrict Obſervance of them, they produc'd the various Effects they were intended for.

THUS much by way of Introduction. There remains now nothing more than to ſhew you what Branches of *Learning* are to be attain'd before we have a juſt Knowledge of Building, which is the Subject and Deſign of the following Work. *I am*,

St. Martin's-Lane,
Jan. 15. 1732.

Your Humble Servant,

X. X.

At a Meeting of this SOCIETY, this 21ſt Day of *December* 1732, the following Manuſcript of VULGAR ARITHMETICK was read, and order'd, that the ſame be Printed for the Firſt Part of *The Principles of Ancient Maſonry*, &c. The Members then preſent,

A——	A——
B——	B——
C——	C——
D——	D——
G——	G——
S——	S——
H——	H——
Q——	Q——
R——	R——
S——	S——
T——	T——
X——	X——
Z——	Z——
&c.——	&c.——

THE

PRINCIPLES

OF

Ancient MASONRY:

OR, A

GENERAL SYSTEM

OF

BUILDING

COMPLEATED.

PART I. *Of ARITHMETICK.*

By A—— A——.

PERHAPS it may be objected by some Persons, who are already skill'd in Arithmetick, that to begin this Work with that Art is unnecessary and useless; and more especially as every Bookseller in *London* is furnish'd with the Works of Arithmeticians, that may be purchased at an easy Rate: But in Consideration, that amongst Mankind there are many who don't already understand Arithmetick, and being able to read, would gladly learn, could they but meet with an Author that was *plain*, *copious*, and *instructive*; whose Stile of Writing was adapted to their Understanding; and the various Examples applied to Practice in immediate Business, incident to their several Professions. I have therefore, for their Sakes, begun this Work with Arithmetick.

I would not be understood herein, that I propose a new System of Arithmetick; but if I *explain* the *Principles* and common *Rules* thereof,

in

in a more *eaſy* and *inſtructive Manner* than has been yet done by any, I have reaſon to believe that this firſt Part will be acceptable, and even to them who are the moſt learned in this Science: for altho' for their own Uſe they may not require ſuch *plain Reaſonings*, as are herein contain'd, yet if they have, or hope to have, Children hereafter, they cannot but be pleaſed in being furniſhed with a *Series of Arts*, ſo well digeſted, and made ready to be imbibed by them in their firſt advance to Learning.

I AM far from finding Fault with the Labours of any one, and more particularly of ſuch Gentlemen that have been ſo good-natur'd to Mankind, as to communicate to the World their ſeveral *Arts* and *Diſcoveries*, for every ones Improvement that pleaſes to read them. But when I ſeriouſly conſider, how ſlenderly the Principles of Arithmetick have, with reſpect to Buſineſs, been handled, even by the beſt of Authors, I can't help thinking, but that, had they been more copiouſly explain'd, their Labours would have been of much greater Uſe to the unknowing Part of Mankind, for whoſe Information ſuch Works were deſign'd, than at preſent they are found to be.

IT was this Motive that induced me to the compiling of this 1ſt Part; which I have endeavoured to render intelligible to the meaneſt Capacity; and I hope will prove entertaining and inſtructive to all my Readers that deſire to be expert Accomptants.

I MUST deſire the young Student, for whoſe Sake this Work is made publick, to conſider, *that unleſs a good Foundation be laid*, there can be but little Hopes of raiſing a ſound Building. And, therefore, ſince the Foundation is to be firſt, and well conſidered, before any Thought need be had about compleating the Structure; ſo we are firſt to *conſider* the *Principles* and *Rules* of thoſe *Arts* that are the Foundation of the *Science* which we deſire to be Maſters of, before we enter upon the Art itſelf: For by being too raſh and impatient herein, is the Reaſon that many who deſire to attain a juſt Knowledge of an Art, are deceived, and can never arrive to the Perfection thereof.

I SHALL perform this Part by Way of Dialogue, between a *Maſter* and *Pupil*, as being the moſt familiar and eaſy Way of teaching.

LECTURE I.

Of NUMERATION, *or the Manner of expreſſing Numbers and Quantities by Characteriſticks, and to pronounce their Value.*

M. AS my Deſign is to inſtruct you fully in all the various *Mathematical Arts* that are neceſſary to make a *compleat Architect*, therefore I muſt, in the firſt Place, acquaint you with *Arithmetick*; that is, *the Art of numbering well*, it being the *Baſis* or *Foundation* of all other Arts. Wherefore I ſhall take ſome Pains to explain the Principles thereof, that you may underſtand the Reaſons of all your future Studies, and be enabled to demonſtrate your ſeveral Operations, as they occur in Practiſe. For, as I before obſerved, unleſs a good Foundation be laid, we can have but ſmall Hopes of raiſing a ſubſtantial Edifice thereon.

P. 'TIS

P. 'TIS *reasonable to believe so: Therefore pray proceed. You say, Sir, That Arithmetick is the Art of numbering well; pray how are Numbers expressed.*

M. NUMBERS are generally expreſs'd by the common Characters following, *viz.* 1, 2, 3, 4, 5, 6, 7, 8, 9, 0; or by Roman Capital Letters thus, I. ſignifies One; II. Two; III. Three; IIII. Four; or thus, IV. V. Five; VI. Six; VII. Seven; VIII. Eight; IX. Nine; X. Ten; XI. Eleven; XII. Twelve; XIII. Thirteen; XIV. Fourteen; XV. Fifteen; XVI. Sixteen; XVII. Seventeen; XVIII. Eighteen; XIX. Ninteen; XX. Twenty; XXI. Twenty-one; XXII. Twenty-two; XXX. Thirty; XL. Forty; L. Fifty; LX. Sixty; LXX. Seventy; LXXX. Eighty; XC. Ninety; C. One hundred; CC. Two hundred; CCC. Three hundred; CCCC. Four hundred; D. Five hundred; DC. Six hundred; DCC. Seven hundred; DCCC. Eight hundred; DCCCC. Nine hundred; M. a thouſand; alſo thus, CIƆ; and ſo the preſent Year 1733, is expreſs'd, MDCCXXXIII; or, CIƆDCCXXXIII. and here obſerve, that as Five is ſignified by V. and Six with V and I placed on the Right Hand thereof; ſo on the contrary, when the I is placed on the Left Hand of V, as in the Number Four; thus, IV. the I leſſens the Value of the V once, and thereby makes it Four; whereas in the Number Six, the I increaſeth its Value one time; and ſo in like Manner when an I is placed after X, as thus, XI. it adds one to its Value, and makes it Eleven; but if it is placed before the X, as thus, IX. it takes One from the Ten, and both together ſignifies but Nine.

THE Number Twenty is expreſs'd by XX, but if between the X's an I is placed, as thus, XIX, the laſt X is thereby leſſened one, and the whole three Letters ſignify but Nineteen: But had the I been placed on the Right Hand, as thus, XXI, then thoſe Letters would have ſignified Twenty-one.

YOU may alſo ſee, that Fifty is repreſented by L, and Sixty by LX; but Forty is expreſs'd by XL: In which laſt, the the X is placed on the Left, whereby the L, Fifty, is made leſs by Ten, and both together ſignify but Forty; but in the former, where the X is placed on the Right Hand, the L, Fifty, is encreaſed Ten, and both together becomes Sixty. Again, If on the Left Hand Side of One hundred, C, be placed an X, as thus, XC, the C or Hundred is thereby made leſs by Ten, and ſignifies but Ninety; whereas, if X had been placed on the Right Hand, as thus, CX, it would have encreaſed the C, and made it One hundred and Ten.

P. I UNDERSTAND *you very well, Sir; but pray, how do you expreſs the ſame Numbers by the Figures you firſt mentioned to me?*

M. To expreſs them, and all other Numbers or Quantities, by thoſe Ten Characteriſticks, *viz.* 1, 2, 3, 4, 5, 6, 7, 8, 9, 0, is a moſt *excellent Invention*; and herein you are to obſerve, that the firſt Nine are called ſignificant Figures, and the laſt, a Cypher, which by itſelf ſignifies nothing.

P. PRAY *what's the Uſe of the Cypher, ſince that of itſelf ſignifies nothing?*

M. ITS Uſe is to augment a Number according to its Place, as thus, 10, where it being placed on the Right Hand of the Figure 1, it makes it Ten, and ſo in like manner 20 ſignifies Twenty, 30 Thirty, 40 Forty, 50 Fifty, 60 Sixty, 70 Seventy, 80 Eighty, 90 Ninety.

AGAIN,

AGAIN, If to the Figure 10, be annex'd, or added one other Cypher, as thus, 100, then the Value of the 10 is augmented ten times, and is become One hundred; and ſo in like manner 200 ſignifies Two hundred, 300 Three hundred, 400 Four hundred, 500 Five hundred, 600 Six hundred, 700 Seven hundred, 800 Eight hundred, 900 Nine hundred, 1000 One thouſand, 2000 Two thouſand, *&c.*

P. VERY *well, Sir, I underſtand it plainly; I ſee that every Cypher encreaſes the Number to which 'tis annexed ten times; that is, if to a Figure* 1 *I add one Cypher, it makes it Ten, and if two Cyphers, it makes it a Hundred, or Ten times Ten; and ſo on, I ſuppoſe, with all other Figures. Pray proceed to the next neceſſary Inſtruction.*

M. THE next Thing in Order, is to ſhew you by the following Table, *how to numerate and expreſs any Number* when written; which is called, NUMERATION.

1	One
12	Twelve
123	One hundred Twenty-three
1234	One thouſand Two hundred and Thirty-four
12345	Twelve thouſand Three hundred and Forty-five
123456	One hundred and Twenty-three thouſand, Four hundred and Fifty-ſix.
1234567	One Million Two hundred and Thirty-four thouſand Five hundred and Sixty-ſeven.
12345678	Twelve Million Three hundred and Forty-five thouſand Six hundred and Seventy-eight.
123456789	One hundred and Twenty-three million, Four hundred and Fifty-ſix thouſand, Seven hundred and Eighty-nine.
1234567890	One thouſand Two hundred and Thirty-four million, Five hundred and Sixty-ſeven thouſand, Eight hundred and Ninety.
kihgfedcba	

P. PRAY *is not to numerate and expreſs Numbers the ſame Thing?*

M. NO: To numerate Numbers is one thing, and to expreſs or read them is another.

P. PRAY *ſhew me the Difference and Manner of both.*

M. I WILL: But *firſt*, you are to obſerve, that the Figures in the firſt Place or Column denoted by *a*, do each ſignify ſo many Units, or One's.

2dly. THE Figures in the ſecond Place or Column, denoted by the Letter *b*, do each ſignify ſo many Ten's; that is, the Figure 1 at the Top ſignifies Ten, the Figure 2 Twenty, the Figure 3 Thirty; and ſo on with all the others down to the Figure 9, which ſignifies Ninety. And if to theſe Figures in the ſecond Column, you add the Units or Ones in the firſt, then the One at the Head of the Place of Units, ſignifies but One; the Figure One in the ſecond Place, with the Figure 2 in the firſt Place, ſignifies Twelve; the 2 in the ſecond, and the 3 in the firſt, ſignifies Twenty-three; the 3 and the 4, Thirty-four; the 4 and the 5, Forty-five; and ſo on with the others. In the third Column every Figure ſignifies ſo many Hundreds, as being ten times greater than thoſe in the ſecond Place: ſo the Unit at the Top ſignifies One hundred; the Number 2, Two hundred; the Number 3, Three hundred; and ſo on of the reſt. Now if to theſe Numbers you add the Numbers in the ſecond and firſt Places, then the firſt Number 1, with the Numbers 2 and 3 in the ſecond and firſt Places, makes One hundred and Twenty-three; the next under them, Two hundred

hundred and Thirty-four; the next under them, Three hundred and Forty-five; and ſo on with the others to the Bottom.

3dly. As the Figures in the ſecond Column exceed the Figures in the firſt ten times, and thoſe in the third Places ten times more than thoſe in the ſecond, ſo likewiſe do thoſe in the fourth Place exceed them of the third Place ten times, and therefore is the Place of Thouſands, and each Figure therein ſignifies ſo many Thouſands; ſo the Figure 1 at the Head ſignifies One thouſand; and if to this you add the oppoſite Figures in the third, ſecond and firſt Places, *viz.* 2, 3, 4, then them taken together with the Number 1, as thus, 1, 2, 3, 4, ſignifies One thouſand Two hundred and Thirty-four. Again, The Figure 2 in the Place of Thouſands, ſignifies Two thouſand, and if to that you add the oppoſite Figures in the other three Places, as before, *viz.* 3, 4; 5, then them taken together with the Number 2, as thus, 2345, ſignifies Two thouſand Three hundred and Forty-five; and ſo on to the Bottom with the others.

4thly. The fifth Place is the Place of Tens of Thouſands, ſo called from its Figures exceeding thoſe of Thouſands in the fourth Place ten times; and therefore the Figure 1 at the Head thereof, ſignifies Ten thouſand, the Figure 2 under it, Twenty thouſand, the Figure 3, Thirty thouſand; and ſo on with the others. Now if to the Figure 1 in the Head of this Column, you add the Figures againſt it in the other four Places, *viz.* 2, 3, 4, 5, then them taken together, as thus, 12345, ſignifies Twelve thouſand Three hundred and Forty-five; ſo in like manner the next Figures under them, *viz.* 23456, ſignifies Twenty-three thouſand Four hundred and Fifty-ſix; and the Figures 34567 under them, ſignifies Thirty-four thouſand Five hundred and Sixty-ſeven; and ſo on in like manner with the others to the Bottom.

5thly. The Figures in the next, or ſixth Place, do alſo exceed them of the fifth ten times, as before, and indeed ſo in the ſame manner in all other Places, be they ever ſo many: Therefore theſe of the ſixth Place become Hundreds of thouſands, as thoſe in the third Place became Hundreds of Units; and the firſt Figure 1 at the Top ſignifies One hundred thouſand, the Figure 2 under it, Two hundred thouſand, the Figure 3 under that, Three hundred thouſand, and ſo on with the others to the Bottom. Now if to theſe three firſt Figures you add reſpectively all thoſe in the other Places, then the Number 123456, will ſignify One hundred Twenty-three thouſand Four hundred and Fifty-ſix; and the Number 234567 under them, will ſignify Two hundred Thirty-four thouſand Five hundred and Sixty-ſeven; and the Figures 345678 under the laſt, Three hundred Forty-five thouſand Six hundred and Seventy-eight.

6thly. The ſeventh Place of Figures is called Millions, and of the ſame Nature as the fourth Place of Thouſands; for as the fourth Place contains Thouſands of Units, ſo this ſeventh Place contains Thouſands of Hundreds; and therefore it, is that a Thouſand Hundreds, or Ten hundred thouſand, is a Million.

The Figure 1 at the Head of the Column, denoted by the Letter *g*, ſignifies One Million; the Figure 2 under it, Two Million; the Figure 3 Three Million, and ſo on; and if to the Figure 1 you add the other Figures of the other Places, *viz.* 234567, then them taken together, that

D is,

is, 1234567, will signify One Million Two hundred and Thirty-four thousand Five hundred and Sixty-seven; and so in like manner, if to the Figure 2 under 1, you add the Figures in the other Places against them, *viz.* 345678, then them taken together, *viz.* 2345678, will signify Two Million Three hundred Forty-five thousand Six hundred and Seventy-eight; and so in like manner with all others to the Bottom.

7thly. IF you consider the Figures in the Place of Millions, as in the Place of Units, supposing a Million to be but One, then you may proceed to the Value of all other Places before it, in the same manner; and as the first Place from Units, is Tens of Units, so likewise the first Place from Millions, is Tens of Millions, the second Place Hundreds of Millions, the third Place Thousands of Millions, and so on without End; as you may see by the following Line, which consists of Thirty Figures.

3
4
5
6
7
. . . . 8 Millions of Millions of Millions of Millions.
5
4
3
2
7
. . . 6 Millions of Millions of Millions.
1
2
3
5
6
. . 7 Million of Millions
1 Hundred thousand of Millions
4 Ten thousand Millions
2 Thousands of Millions } Millions.
6 Hundreds of Millions
3 Tens of Millions
. . 4 Millions
5 Hundreds of Thousands
7 Tens of Thousands } Thousands.
2 Thousands
1 Hundreds
7 Tens } Hundreds.
9 Units

P. I THINK *I understand you herein; that is, in the Table, the Figure* 1 *denotes in the first Place One, in the second Place Ten, in the third Place a Hundred, and so on in the rest of the Places, when 'tis consider'd with the following Figures that are against it in the other Places. But suppose that those other Figures were taken away, and the Figures of* 1 *only left in their respective Places, how shall I know their Values at such Times; that is, suppose the Figure* 1 *in the Place Thousands, which has the Figures* 2,3,4 *standing against it, had those Figures* 2, 3, 4, *taken away from it, how must I understand that Figure* 1 *to signify One thousand?*

M. YOU must always, in such Cases, supply the Places of those Figures so taken away, with as many Cyphers, as thus, 1000; for, as I told you before, the Use of Cyphers is to encrease the Value of a Figure, according to the Number of Places, as in the following Tables.

10 *Ten*

10 Ten.	20 Twenty.	30. Thirty.
100 One hundred.	200 Two hundred.	300 Three hundred.
1000 One thousand.	2000 Two thousand.	3000 Three thousand.
10000 Ten thousand.	20000 Twenty thousand.	30000 Thirty thousand.
100000 Hundred Thousand.	200000 Two hundred Thousand.	300000 Three hundred Thousand.
1000000 One million.	2000000 Two million.	3000000 Three million.

P. I UNDERSTAND *you very well, and thank you for this Instruction. Pray now, if convenient, proceed to inform me how to numerate or number Quantities, and to read or express them, as you before promised.*

M. I WILL: To numerate Quantities you must begin at the Right Hand or Place of Units, and number them backward unto the Left Hand, calling the several Figures to be numbered, by their respective Names in the Places wherein they stand; as for Example, to number the following four Figures 1234, I begin with the Figure 4 in the Place of Units, and so proceed on to the 1, saying, Units, Tens, Hundreds, Thousands, and then express them thus, *One thousand Two hundred and Thirty-four*; and so in like manner any other Quantity, as in the above Line of Thirty Figures are expressed.

WHEN Quantities consist of fewer Figures or Places than Ten, as 123, or 123456, or 123456789, then 'tis best to point every third Figure from the Place of Units, as thus, 1234 in four Figures; thus, 123456 in six Figures; and thus in nine Figures, 123456789; and then you may readily number and express them; because the first three are in the Place of Hundreds; the second three to the second Point, in the Place of Thousands; and the last three in the Place of Millions; which you read thus, *viz.* first three, *One hundred and Twenty-three Millions*; the second three, *Four hundred and Fifty-six Thousand*; and the last three, *Seven hundred and Eighty-nine*; and so in like manner all other Numbers.

WHEN Numbers are very long, as in the preceeding Line of Thirty Figures, 'tis best to *point out the Places of Millions*, as you see pointed underneath the said Line, which Line may then be thus read, *viz. Three hundred Forty-three Thousand, Six hundred Seventy-eight Millions of Millions of Millions of Millions, Five hundred Forty-three thousand Two hundred and Seventy-six Millions of Millions of Millions, One hundred Twenty-three Thousand Five hundred and Sixty-seven Millions of Millions, One hundred Forty-two thousand Six hundred and Thirty-four Million, Five hundred Seventy-two thousand, One hundred and Seventy-nine.*

P. I THANK *you, Sir; I am now able to express and number any Quantity: Pray what's my next Instruction?*

M. THE next Thing in Order is *Addition*, or the manner of collecting or gathering together divers Quantities or Numbers into one total Sum: But before I proceed thereto, I must acquaint you with the Measures, Weights, &c. by which are determin'd the several Quantities of our Materials employed in Buildings.

THE Measures by which the several Parts of Lands and Buildings are measured, are 1. Measures of Length, called *Running Measures.* 2. Measures of Length and Breadth, called *Square* or *Superficial Measures.* 3. Measures

ſures of Length, Breadth, Depth, or Thickneſs, called *Solid* or *Cubical Meaſure*.

THESE various Meaſures I will exhibit in the following TABLES, which, by Inſpection, ſhews you their Magnitudes and Proportions to each other.

TABLE I. *Of Meaſures of Length.*

Barley Corns												
[illegible]	*Inch*											
[illegible]	[illegible]	*Feet*										
[illegible]	[illegible]	3	*Yards*									
[illegible]	[illegible]	6	2	*Fathoms*								
[illegible]	[illegible]	16 ½	5 ½	2 ¾	*Pole, Rod, or Perch*							
[illegible]	[illegible]	[illegible]	22	11	4	*Chain or Acres Breadth*						
[illegible]	[illegible]	[illegible]	220	110	40	10	*Rood, Furlong, or Acres Length*					
190080	[illegible]	5280	1760	880	320	80	8	*Mile*				
[illegible]	[illegible]	15840	5280	2640	960	[illegible]	24	3	*League*			
[illegible]	[illegible]	[illegible]	105600	52800	[illegible]	4800	480	60	20	*Degree*		
[illegible]	[illegible]	[illegible]	38016000	[illegible]	[illegible]	1728000	172800	21600	[illegible]	360	*Reputed Circumference of the Earth.*	

TABLE II. *Of Square Meaſure.*

Square Inches						
144	*Square Foot*					
1296	9	*Square Yard*				
14400	100	11 $\frac{1}{9}$	*Square of Ten Feet*			
39204	[illegible]	30 [illegible]	[illegible]	*Square Rod, Pole, or Perch*		
627624	4356	484	43 [illegible]	16	*Chain Square*	
4865640	[illegible]	3728 $\frac{4}{9}$	335 [illegible]	160	10	*An Acre of Land*

III. THE *Solid Meaſures* are commonly but two, *viz.* the *Solid Foot* conſiſting of 1728 *Solid* or *Cubical Inches*; and the *Solid Yard*, which conſiſts of 27 *Solid Feet.*

IV. THE Weights by which divers of the Materials uſed in Building are weighed, are called *Avoirdupoize Weight*, which takes its Beginning from a Dram, altho' ſeldom any ſuch ſmall Weight is made uſe of in weighing the Materials of a Building.

Note, AN Ounce Avoirdupoize hath been exactly weighed, and found to contain 681 Grains of Barley.

Drams						
16	*Ounce*					
256	16	*Pound*				
7168	448	28	*Qu. of Hundred*			
14336	896	56	2	*Half a Hundred*		
28672	1792	112	4	2	*A Hundred*	
573440	35840	2240	80	40	20	*Ton*

V. THE

V. THE various Kinds of Materials uſed in Buildings, have their own particular Ways of Numbering. As for Example :

A Fodder of Lead is Nineteen hundred and half; or, 2184 Pounds *Avoirdupoize.*

A Load of Timber 50 ſolid Feet; a Ton of Timber 40 Feet.
A Load of Earth 27 ſolid Feet, or a cubical Yard.
A Load of Bricks 500 Bricks; a Load of Plain-tiles a Thouſand.
A Load of Sand 18 Buſhels.
An Hundred of Lime 25 Baggs, equal to 25 Buſhels.
A Load of Lime in the Country is about 40 Buſhels.
An Hundred of Deals, contains ſix Score, or 120; as alſo Nails the ſame.

$$\left.\begin{array}{lr}\text{An hundred Weight of Iron, Lead, \&c.} & 112\\ \tfrac{3}{4}\text{ of an Hundred} - - - - - & 84\\ \tfrac{1}{2}\text{ an Hundred} - - - - - & 56\\ \tfrac{1}{4}\text{ of an Hundred} - - - - - & 28\end{array}\right\}\text{Pounds.}$$

$$\text{A Load of}\left\{\begin{array}{l}1\\ 1\tfrac{1}{2}\\ 2\\ 3\\ 4\end{array}\right\}\text{Inch thick Plank, is}\left\{\begin{array}{r}600\\ 400\\ 300\\ 200\\ 150\end{array}\right\}\text{Square Feet.}$$

Laths five Score to the Hundred of five Feet long ; and when but four Feet long, then 120 to the Bundle ; which ſhould be Inch and half broad, and half an Inch thick.

I HAVING thus ſhewn you the Numeration, and Kinds of divers Quantities, I ſhall now proceed to ſhew you how to collect them together into one Sum-Total, when before divided into divers Parts or Parcels ; which is call'd ADDITION, and the Second Rule of *Arithmetick.*

LECTURE II.

Of ADDITION.

P. W*HAT is* ADDITION ?

M. ADDITION is the gathering together of divers Numbers and Quantities into one Sum or Body, which is called the Total Sum.

P. PRAY, *is Addition divided into many Kinds* ?

M. YES ; there are many Kinds of Addition ; as Addition of Integers, Money, Materials, *&c.* as you'll ſee in this Lecture.

P. PRAY *what do you mean by Integers* ?

M. AN Integer is a whole Number ; as 1, or 2, or 5, or 20, without any broken Parts belonging to it, as $\frac{1}{2}$, or $\frac{1}{4}$, which are called broken or fractional Parts : And when ſuch fractional Numbers, are annex'd to Integers, or whole Numbers ; as $1\frac{1}{2}$, $2\frac{3}{4}$, $3\frac{4}{7}$, then ſuch Numbers are called mix'd Numbers.

BUT, however, let the Nature of your Numbers to be added, be as they will, you must always observe the following

RULE.

TAKE *care to place each Kind in their true Places; Units under Units, Tens under Tens, Hundreds under Hundreds,* &c. *and then in the Addition of Integers, for every Ten that you find in each Place of Figures, carry one to the next Place.*

Example.

	7654321
	242013
	34567
	3215
	173
	23
	1
Total	7934313

To perform this Example, begin at the Bottom of the Place of Units, and say, 1 and 3 is 4, and 3 is 7, and 5 is 12, and 7 is 19, and 3 is 22, and 1 is 23: Then because that in 23 there are two Tens, therefore set down under the Line the odd 3, and carry 2 to the next Place of Tens; saying, 2 that I carry, and 2 is 4, and 7 is 11, and 1 is 12, and 6 is 18, and 1 is 19, and 2 is 21; set down 1, and carry 2 to the next Place of Hundreds; then 2 I carry, and 1 is 3, and 2 is 5, and 5 is 10, and 3 is 13; set down 3, and carry 1, because you have Ten but once in 13: Then say, 1 I carry, and 3 is 4, and 4 is 8, and 2 is 10, and 4 is 14; set down 4, and carry 1, and say, 1 I carry, and 3 is 4, and 4 is 8, and 5 is 13; set down 3, and carry 1; then say, 1 I carry, and 2 is 3, and 6 is 9; set down 9, because you have not Ten therein: Lastly, 7 is 7; therefore place the 7 before the 9, and your Work is done.

Now, from this Example 'tis plain, that in Addition, all the Numbers taken together, are equal to the Sum. I will add the following Examples for your Practice.

12	123	1234	12345	123456	1234567
21	213	2143	21354	214365	2135476
12	231	2413	23145	241356	2314567
21	321	4231	32415	423165	3241657
12	312	4321	34251	432615	3426175
21	132	3412	43521	346251	4362715
12	123	3142	45312	364521	4637251
		1324	54132	635412	6473521
		1342	51423	653142	6745312
			15243	561324	7654132
			12534	516342	7561423
				153624	5716243
				135642	5172634
					1527364
					1253746

P. SIR, *I am greatly obliged to you for these various Examples given me for Practice; but before I proceed thereto, pray answer me the following Question: Whether or no, there is any other thing to be regarded in the placing of Numbers to be added, more than to place their several Units, Tens, &c. in their respective Places?*

M. NO; that is all, and therefore you need not regard with which of any given Numbers, you set down at first in the middle or last: That is, suppose the following Numbers were given to be added together, *viz.* 10, 501, 7235, 40, 90, you may place them

	90		7235		501		10
	40		90		10		501
Thus	7235	or thus,	40	or thus,	7235	or thus,	7235
	501		10		90		40
	10		501		40		90
	7876		7876		7876		7876

Here you see, that tho' every one differ in their manner of placing, yet the total Sum is the same to them all.

I SHALL now shew you how to add up Sums of Money. The Addition of Money, is called Addition of Numbers of divers Denominations, as of *Farthings*, *Pence*, *Shillings*, and *Pounds*; wherein you are to observe the following

RULE.

OBSERVE *that every Denomination be placed under its correspondent Denomination; that is, as in the Addition of Integers, you were taught to place Units over Units, Tens over Tens, &c. So in this, you must place Pounds over Pounds, Shillings over Shillings, Pence over Pence, and Farthings over Farthings.*

THEN for every 4 contain'd in the Place of Farthings, carry 1 to the next Place of Pence, because 4 Farthings make 1 Penny; also, for every 12 contain'd in the Place of Pence, carry 1 to the next Place of Shillings, because 12 Pence make 1 Shilling; likewise, for every 20, contain'd in the Place of Shillings, carry 1 to the Place of Pounds, because 20 Shillings make one Pound Sterling: Lastly, add up the Pounds as you was before taught of the Integers, because here in this Case the Integer is a Pound, and the Shillings are Parts thereof, which I before told you are called fractional Parts: But more of them in their Place.

Example.

l.	s.	d.	q.
123	17	6	2
1	11	2	1
1276	5	00	3
800	19	11	1
30	11	10	2
5	8	2	1
1555	7	8	3
3794	01	05	3

To

To add theſe Sums together, you muſt begin with the Column of Farthings; and ſay, 3 and 1 is 4, and 2 is 6, and 1 is 7, and 3 is 10, and 1 is 11: Now becauſe in 11 Farthings you have 4 twice, and 3 remains, therefore place 3 at Bottom, and carry the 2 to the Place of Pence, and ſay, 2 that I carry, and 8 is 10, and 2 is 12, and 10 is 22, and 11 is 33, and 2 is 35, and 6 is 41: Now ſince that in 41, you have 12 three times, which is 36, and 5 is remaining, therefore ſet down the 5 under the Pence, and carry the 3 Shillings to the Place of Units in the Place of Shillings, and ſay, 3 that I carry, and 7 is 10, and 8 is 18, and 1 is 19, and 9 is 28, and 5 is 33, and 1 is 34, and 7 is 41; ſet down 1, and carry 4 to the Place of Tens, in the Shillings, and ſay 4 I carry, and 1 is 5, and 1 is 6, and 1 is 7, and 1 is 8, which is 80 Shillings, wherein you have 20, four times, and 0 remains, therefore ſet down 0 under the Tens of the Shillings, and carry 4 to the Place of Pounds, which add together, as before taught, of the whole Numbers, or Integers, and the total Sum will be 3794 Pounds, 01 Shilling, 05 Pence, and 3 Farthings.

I SHALL now give you ſome Examples for Practice.

Example I.

l.	s.	d.	q.
	1	7	2
	19	8	1
	10	11	3
	16	8	2
	00	7	2
	00	00	3

Example II.

l.	s.	d.
123	19	11
7	10	2
8	3	5
127	11	2
6	4	8

Example III.

l.	s.
1243	10
7963	11
12765	8
742	19
2222	6
188	7
5	8
6	10
12345	11

Example IV.

l.	s.	d.
12	0	5
7	0	2
11	0	3
16	0	10
15	0	9
17	0	10
10	0	11
8	0	9

IN theſe Four Examples you have ſome Variety: The firſt conſiſts of Shillings, Pence and Farthings; the ſecond, of Pounds, Shillings, and Pence; the third of Pounds and Shillings, and the fourth of Pounds and Pence. To perform the firſt Example, you begin with the Farthings, and for every 4, carry 1 Penny to the Place of Pence, and for every 12 therein, carry 1 to the Place of Shillings, and for every 20 therein, carry 1 to the Place of Pounds, and place them down in their reſpective Places; altho' in this Example there's no Pounds added, but ſuch as ariſe by the Addition of the Shillings: Then proceed in like manner to the working of the other Examples.

BUT ſeeing that when you have caſt up your Column of Pence, the Sum thereof may ſometimes be very large, and you may not readily know how many Shillings are contained therein, you muſt, before you proceed any further, learn the two following Tables by Heart.

Table

Table I.

d.		s.	d.
20	is	1	8
30		2	6
40		3	4
50		4	2
60		5	00
70		5	10
80		6	8
90		7	6
100		8	4
110		9	2
120		10	00

Table II.

s.		d.
1	is	12
2		24
3		36
4		48
5		60
6		72
7		84
8		96
9		108
10		120

IN the firſt of theſe Tables the Numbers on the Left Hand are Pence, and thoſe on the Right; the firſt are Shillings, and the ſecond Pence, and are thus to be read; 20 *d.* is 1 *s. and* 8 *d.* 30 *d.* is 2 *s.* 6 *d.* 40 *d.* is 3 *s.* 4 *d.* 50 *d.* is 4 *s.* 2 *d.* 60 *d.* is 5 *s.* 0 *d.* &c. This Table, when learn'd, will ſhew you readily how to divide out your Shillings in the adding up of your Pence.

THE ſecond Table is alſo very uſeful, in ſhewing you the Number of Pence contain'd in any Number of Shillings, under Ten; and which, being once learn'd, will be very ready and uſeful to you.

BEFORE I proceed any further, you muſt here obſerve, that altho' in the two firſt Examples hereof, I have placed the Farthings in a diſtinct Column by themſelves, for your more eaſy adding them together, and to ſee the Reaſon thereof; yet that Method is not practiſed by Merchants or Tradeſmen, whoſe Method is to place the Farthings cloſe to the Column of Pence, *viz.* For one Farthing, they ſet $\frac{1}{4}$, for a Half-penny $\frac{1}{2}$, and for Three Farthings $\frac{3}{4}$; therefore to expreſs Four-pence Farthing, I write it thus 4 *d.* $\frac{1}{4}$, and Six-pence Half-penny thus, 6 *d.* $\frac{1}{2}$, and Ten-pence Three Farthings, thus, 10 *d.* $\frac{3}{4}$.

IT is alſo neceſſary before you proceed to the Addition of great Sums, that you firſt get this following Table by Heart alſo; after which, your Work will be eaſy.

A TABLE *ſhewing the Number of Shillings contain'd in Twenty Pounds Sterling.*

l.		s.	l.		s.
1	is	20	11	is	220
2		40	12		240
3		60	13		260
4		80	14		280
5		100	15		300
6		120	16		320
7		140	17		340
8		160	18		360
9		180	19		380
10		200	20		400

P. I PERFECTLY *understand these Tables, and have them by Heart; therefore be pleased to proceed.*

M. WHEN Sums are very long, as in the following Example, you may divide them into Parts; and the Parts added together, will be equal to the Whole. But otherwise to perform it at one Operation, this is

The RULE.

FIRST *cast up the Farthings, as before taught, and carry the Pence (if any) to the Pence in the Units Place of Pence, which number up to the Top, and then you may come back again down in the Place of Tens as fast as you can speak, and by the preceding Pence Table, easily tell how many Shillings (if any) are contain'd in the Pence; and place the odd remaining Pence (when any) under the Line, and carry the Shillings to the Place of Shillings: This done, number up the Shillings in the Units Place, and back again down the Place of Tens; and then finding how often* 20 *is contain'd therein, set down the remains (if any) and carry the Pounds to the Place of Pounds, which add up as before taught.*

Example.

l.	s.	d.
10	1	[illegible]
15	3	[illegible]
11	*b* 19	2
110	18	*a* 10
106	15	4
111	17	11
16	8	3
7	6	2
18	14	6
27	13	11
14	16	10
17	9	8
222	19	10½
111	11	2
18	17	5
16	7	9
7	5	1
9	6	3
22	11	2
27	14	6
26	10	8¼
932	9	6¼

OPERATION.

FIRST, I begin with the Farthings, and say, ½ and ¾ is 5, and ¼ is 6, and ½ is 8, and ¼ is 9, and ¾ is 12, and ¼ is 13 Farthings in all, which is Three-pence ¼, wherefore I put down the ¼ under the Line, and carry 3 to the Place of Pence, and say, 3 that I carry, and 8 is 11, and 6 is 17, and 2 is 19, and 3 is 22, and 1 is 23, and 9 is 32, and 5 is 37, and 2 is 39, and 8 is 47, and 1 is 48, and 6 is 54, and 2 is 56, and 3 is 59, and 1 is 60, and 4 is 64, and 2 is 66, and 8 is 74, and 2 is 76: So I am now come to the Top or uppermost Figure, from whence I go again downwards in the Place of Tens, saying, 76 and 10 at *a* is 86, and 10 is 96, and 10 is 106, and 10 is 116, and 10 is 126: Now by the preceding Pence Table, 100 Pence is 8 s. 4 d. and 26 Pence is 2 s. 2 d. making in the whole 10 s. 6 d.

SECONDLY, Set the 6 Pence under the Pence, and carry the 10 Shillings to the Place of Shillings, and then beginning with the Units thereof only, number them to the Top, saying, 10 that I carry and 4 is 14, and 1 is 15, and 6 is 21, and 5 is 26, and 7 is 33, and 7 is 40, and 1 is 41, and 9 is 50, and 9 is 59, and 6 is 65, and 3 is 68, and 4 is 72, and 6 is 78, and 8 is 86, and 7 is 93, and 5 is 98, and 8 is 106, and 9 is 115, and 3 is 118, and 1 is 119: Now since that 119 Shillings is 11 times ten Shillings, and 9 over, I set down the 9 at the Bottom of the Units, then I descend down the Place of Tens, beginning at *b*, saying, 11 I carry from the Units of Shillings, and

11 is

1 is 12, and 1 is 13, and 1 is 14, and 1 is 15, and 1 is 16, and 1 is 17, and 1 is 18, and 1 is 19, and 1 is 20, and 1 is 21, and 1 is 22, and 1 is 23, and 1 is 24, which is twelve Pounds; therefore carry the Pounds to the Place of Pounds, and then proceed to caſt them up, as you did whole Numbers in the firſt Example, and the Sum will come out 932 Pounds 9 Shillings and Six-pence 1 Farthing.

THIS is the moſt common Method of adding Quantities together, and which I have endeavoured to render as eaſy as poſſible; but leſt that your Memory may be too much affected, I therefore recommend the following

RULE.

HOW *to perform Addition, without the Trouble of carrying One for every Ten, &c. to the next Place, as before taught, which you'll find to be of very great Uſe in the Addition of large Sums.*

The Manner thereof is as follows.

LET the eight Numbers in Example I, denoted by the Letters *a b c d e f* be given to be added, as aforeſaid.

PRACTICE.

FIRST add up the Column of Units denoted by *f*, as before taught, ſaying 2 and 7 is 9, and 7 is 16, and 1 is 17, and 5 is 22, and 2 is 24, and 7 is 31, and 6 is 37; ſet 37 underneath, with the 7 under the Place of Units.

SECONDLY, Begin again with the ſecond Column or Place of Tens, denoted by *e*, which add up into one Sum, and place it under the ſame as before, always obſerving, that the Units thereof are placed under the Line of Figures added, and the Tens under the next Place; ſo here, the Sum of this ſecond Column *e* being 31, therefore place the 1 under the ſame, and the 3 under the next Place *d*. Proceed in like manner, with the remaining four Columns, whoſe Sums will be found to be 36, 39, 19, 57, which being added together, their Sum will be the total Sum required.

Example I.

	a	*b*	*c*	*d*	*e*	*f*
	7	2	4	5	3	6
	9	2	3	4	2	7
	6	1	7	5	9	2
	1	2	5	7	3	5
	8	5	4	3	2	1
	9	3	2	5	4	7
	8	2	9	3	5	7
	9	2	5	4	3	2
					3	7
				3	1	
			3	6		
		3	9			
	1	9				
5	7					
		1	2	9	4	7
	1	2				
5	8					
5	9	3	2	9	4	7

NOW I muſt obſerve to you, that by this Method of Addition, you will be leſs liable to Errors, than in the foregoing, where you carry the Tens forward, becauſe here the Mind is diſcharged every time at the caſting up of each ſingle Column.

AND again, if an Error ſhould at any time happen, its much eaſier diſcovered herein, by examining each Column ſingly, than in the preceding Method, wherein it generally happens, that we muſt paſs through the whole Operation to come at the Truth, and even then, if the Memory is overcharged, be deceived at laſt, and miſs of the true Sum required: Beſides, this Method of Addition admits of beginning in any Part thereof, without being confined to the Place of Units; which inſtead of being the firſt Numbers added, may be laſt, as I ſhall illuſtrate in Example II. following.

FIRST

FIRST add up the Column *a*, whoſe Sum is 57, which place under the ſame. Secondly, add up the Column *b*, whoſe Sum is 19, which place under the ſame, ſetting the 9 under the Column *b*, and the 1 under the 7. Thirdly, add up the Column *c*, whoſe Sum is 39, which place under the ſame, ſetting the 9 under the Column, and the 3 under the 9 of the laſt Product 19. Fourthly, proceed to place the Sums of the other three Columns in like manner, and adding them together, after the common Manner, their Sum will be the Total required.

Example II.

	a	*b*	*c*	*d*	*e*	*f*
	7	2	4	5	3	6
	9	2	3	4	2	7
	6	1	7	5	9	2
	1	2	5	7	3	5
	8	5	4	3	2	1
	9	3	2	5	4	7
	8	2	9	3	5	7
	9	2	5	4	3	2
5	7	9	9	6	1	7
	1	3	3	3	3	
5	9	3	2	9	4	7

THUS you ſee, that by this Method, you may begin and end your Addition at Pleaſure, either forwards, backwards, or in the middle, and with one and the ſame Trouble; which I muſt deſire you to well obſerve.

P. I WILL, *Sir*; *and with a great deal of Pleaſure alſo. But pray, Sir, cannot Sums of divers Kinds, as Money*, &c. *be added together by this new Method.*

M. YES; Money, Materials, &c. may be thus added, the Method is univerſal: But that you may well underſtand the ſame, I will give you an Example thereof.

LET the Sums in Example III be given to be added together according to this Method.

Example III.

l.	s.	d.	q.
725	19	11	3
125	14	9	2
578	15	10	1
924	17	11	3
187	9	10	2
732	17	5	3
		3	2
		8	
	4		
4	11		
31			
24			
30			
3275	15	11	2

As it is the moſt orderly Manner to begin the Addition with the Farthings, I will, for Order ſake, begin with them and end with the Pounds; but otherwiſe, I might have begun with the Pounds, and ended with the Shillings, or Pence, at Pleaſure.

FIRST ſay, 3 and 2 is 5, and 3 is 8, and 1 is 9, and 2 is 11, and 3 is 14: Now, becauſe 14 Farthings are equal to 3 Pence 2 Farthings, therefore ſet 2 Farthings under the Place of Farthings, and 3 under the Place of Pence.

SECONDLY, Begin with Units of the Pence, and ſay, 5 and 1 is 6, and 9 is 15, and 1 is 16, (and coming down the Place of the Tens, in the Pence) ſay, 16 and 10 is 26, and 10 is 36, and 10 is 46, and 10 is 56. Now, becauſe that 56 Pence is equal to 4 Shillings and 8 Pence, therefore ſet down 8 under the Place of Pence, and 4 under the Place of Shillings.

THIRDLY, Begin with the Units of the Place of Shillings, and ſay, 7 and 9 is 16, and 7 is 23, and 5 is 28, and 4 is 32, and 9 is 41; then coming down the Place of Tens in the Shillings, ſay, 41 and 10 is 51, and 10 is 61, and 10 is 71, and 10 is 81, and 10 is 91. Now, becauſe that 91 Shillings are equal to 4 Pounds and 11 Shillings, therefore ſet down the 11 under the Place of Shillings, and the 4 under the Place of Pounds.

FOURTHLY,

FOURTHLY, add together the Sums of the three Columns of Pounds, as before taught, and then their ſeveral Sums added together, will be the total Sum required.

THUS have I made Addition in all its Varieties, very plain, which, I hope, you will carefully remember.

P. *It is true Sir. But, pray, how am I to depend upon the Totals, when I have caſt them up; that is, how ſhall I know whether they be true or falſe?*

M. WHAT you now aſk, I will readily inform you; this is *the Proof of Addition,* and may be performed after two different Manners. As for Example; let the five following Sums be added together.

	l.	s.	d.	
	1274	16	4	
E				E
	1243	19	2	
	1800	11	9	
	18	17	6	
	5	9	4	
Sum	4343	4	1	A
Proof	4343	4	1	B
	3068	7	9	C
Proof	4343	4	1	D

IN the Operation of this Example, firſt, add together from the Bottom upwards, into one Total, the five upper Sums, which appears to be 4343 l. 4 s. 1 d. as at A. Secondly, inſtead of adding up each Place of Pence, Shillings, and Pounds, by beginning at the Bottom of each Column as before, begin at the Top of each Column, and add them downwards, and if then the Total is the ſame as before, you are right, elſe not: So here the Sum at B, produced by the Addition downwards, is the ſame as the Sum at A produced by the Addition made upwards as uſual. This is one Way to prove Addition, which may be alſo done as following. Draw a Line underneath the upper Row of Figures, as EE; and then add together the four under Sums into one Sum, as C, to which add the uppermoſt Number before cut off; and if their Total D is equal with the other Total A, you may aſſure yourſelf of the Operation being truly performed; becauſe *the Whole is always equal to all its Parts taken together.*

P. I UNDERSTAND *this moſt reaſonable Proof of Addition. Pray be pleaſed to give me divers Queſtions that relate to Meaſures,* &c.

M. I WILL: But I am apprehenſive, that amongſt the Variety following, you will meet with ſome that you'll not be Maſter of until you have learned Subtraction. However, be not diſhearten'd thereat, becauſe I ſhall ſoon learn you to ſubtract, and then they will become eaſy.

Example I. *Of Integers.*

THERE are five Windows that have Moldings about them.

I DEMAND *how many Inches of Moldings there are in the Whole?*

		Inches.
The	firſt contains	227
	Second	250
	Third	1500
	Fourth	1200
	Fifth	800
	P. Anſwer	3977

Example II. *Of Integers.*

M. THERE are six Brick-walls that are covered with Stone copping.

I DEMAND *how many Feet of Copping are in the Whole*?

		Inches.
The	first is in Length	525
	Second	300
	Third	272
	Fourth	1500
	Fifth	1872
	Sixth	221
P.	Answer	4690

Example III. *Of Feet and Inches.*

M. A PAINTER hath painted the Cornices of five Houses, which are all of the same Girt, and are to be paid for *runing Measure.*

I DEMAND *how many Feet, runing Measure, in the Whole*?

Note, Here, for every 12 contained in the Place of Inches, you must carry 1 to the Place of Feet, and then proceed as Integers.

		Feet	Inches.
The	First House girts	210	11
	Second	504	9
	Third	601	10
	Fourth	200	4
	Fifth	150	9
P.	Answer	1668	07

Example IV. *Of Yards, Feet and Inches.*

A JOYNER has hung ten Sash Windows, and used Line for the same, as follows.

I DEMAND *how many Yards he has used in the Whole* ?

Note, That for every 12 Inches, you carry 1 Foot, and for every 3 Feet, you carry 1 Yard, and then add up the Yards as Integers.

		Yards	Feet	Inches.
To the	First Sash	6	2	7
	Second	6	1	11
	Third	4	2	10
	Fourth	8	1	5
	Fifth	3	0	9
	Sixth	7	1	2
	Seventh	6	2	11
	Eighth	8	1	10
	Ninth	2	2	2
	Tenth	7	2	10
P.	Answer -	64	2	05

FOR your ready finding how many Feet are contain'd in any Number of Inches under 120, or how many Yards in any Number of Feet under 30, you should get the following Tables by Heart; and until you are Master thereof, you may by Inspection have your Demands answer'd.

Table

Table I. Inch	is	Feet.	*Table* II. Feet	is	Yard.
12		1	3		1
24		2	6		2
36		3	9		3
48		4	12		4
60		5	15		5
72	is	6	18	is	6
84		7	21		7
96		8	24		8
108		9	27		9
120		10	30		10

As for Example.

IN the laſt Example, the Column of Inches amounted unto 77. Look in Table I, and in the firſt Column under the Word *Inch*, find the neareſt Number to 77, which is 72, againſt which ſtands 6, the Number of Twelves contain'd therein; then ſet down the remaining 5, and carry the 6 to the Place of Feet, and add them together, which amounts to 20: This done, look in Table II, under the Word *Feet*, and find the neareſt Number to 20, which is 18, againſt which ſtands 6, the Number of Yards contain'd therein, which carry to the Place of Yards, and ſet down the remainder two, under the Column of Feet; then add up the Yards as Integers.

P. THESE *Tables I apprehend will be very uſeful in caſting up large Sums, and therefore I think it adviſeable to continue them to greater Numbers, and for that Purpoſe, deſire that you'll ſhew me your Rule for making them.*

M. THE *Rule* for making theſe and all other ſuch Tables is, firſt, to double the Number you begin with, and to that Sum, add the ſame Number again, and to the next, and every Sum after, add the firſt or uppermoſt Number, and againſt each Number ſo added, ſet the Number of Times in the ſecond Column.

As for Example.

I WOULD make Table I. for dividing Inches into Feet. Firſt write down 12 the Number of Inches in one Foot, and againſt it write 1, then double the 12, and it makes 24, which ſet under the 12, and againſt it ſet 2 under the 1 aforeſaid; to this 24 add the 12 over it, and it makes 36, which write under 24, and ſet 3 againſt it, ſignifying three times 12; to 36 add the upper or firſt Number 12, and it makes 48, and againſt it place the Number 4 in the ſecond Column. Proceed on in this Manner, and you may continue your Table to any Length you deſire.

P. I UNDERSTAND *you; pray proceed to other Examples.*

M. I WILL; and as Occaſion requires, ſhall make you the like Tables to each Example.

Example V. *Of Fathoms, Yards, Feet and Inches.*

A LABOURER was employ'd to dig down a Well, and was six Days in doing it.

I DEMAND *how deep he dug down in that time?*

The	Fath.	Yds.	Feet.	Inches.
First Day he went down	2	1	2	11
Second Day	5	0	1	9
Third Day	4	1	1	7
Fourth Day	3	1	2	6
Fifth Day	3	1	1	10
Sixth Day	4	0	2	5
P. Answer	25	0	1	00

Note, Add up the Inches, Feet, and Yards, as in the last Example; and for every two Yards, carry one to the Fathoms, and add them as Integers.

Example VI. *Of Rods and Feet.*

A CARPENTER hath set up five Lengths of Pailling.

I DEMAND *how many Rods there are in the Whole?*

In the	Rod	Feet.
First there is	20	2
Second	43	1 ½
Third	70	1
Fourth	110	2 ¼
Fifth	65	1 ¾
P. Answer	308	8 ½

M. FOR your ready reducing your Column of Feet into Poles, I will give you the following Table, shewing the Number of Feet in any Number of Poles not exceeding Ten.

TABLE.

Pole.		Feet.	Pole.		Feet.
In 1	there is	16½	In 6	there is	99
2		33	7		115½
3		49½	8		132
4		66	9		148½
5		82	10		165

P. I THANK *you, Sir; I see by this Table, that I must carry* 1 *to the Column of Poles for every* 16 ½ *found in the Column of Feet.*

M. YOU understand me rightly, therefore I shall proceed to

Example VII. *Of Chains and Links.*

A LABOURER, to enclose divers Lands, hath digged and planted five Fences.

I DEMAND *how many Chains Length he hath done in the Whole?*

Note, For every 100 in the Column of Links, carry 1 to the Column of Chains, and add the Chains as Integers.

The	Chains.	Links.
First is in Length.	221	91
Second	123	74
Third	376	22
Fourth	179	99
Fifth	242	89
P. Answer	1144	75

Table

	Chains.		Links.			
In	1	there is	100	equal to	4	Rods length
	2		200		8	
	3		300		12	
	4		400		16	
	5		500		20	
	6		600		24	
	7		700		28	
	8		800		32	
	9		900		36	
	10		1000		40	
	¾		75		3	
	½		50		2	
	¼		25		1	

Example VIII. *Of Tuns, Hundreds, Quarters and Pounds.*

A SMITH hath made five Parcels of Iron-work.

I DEMAND *the total Weight of the Whole?*

		Tun	Hund.	qrs	lb.
The	First weighs	2	98	3	27
	Second	3	19	2	18
	Third	27	9	1	25
	Fourth	25	17	2	11
	Fifth	4	10	3	24
P.	Anfwer	68	16	2	21

Note, That for every 28 Pounds contained in the firft Column of Pounds, carry 1 to the next Column of Quarters of a Hundred. 2*dly*, For every 4 contained in the Column of Quarters, carry 1 to the Column of Hundreds, and for every 20 in the Column of Hundreds, carry 1 to the Column of Tuns, and then add them up as Integers.

Table I. *Shewing the Number of Pounds in every Quarter of an Hundred unto three Hundred.*

	Quarters of a Hund.		Pounds.		Quarters of a Hund.		Pounds.
In	1	there is	28	In	7	there is	196
	2		56		8		224
	3		84		9		252
	4		112		10		280
	5		140		11		308
	6		168		12		336

Table II. *Shewing the Number of Quarters in* 10 *Hund. Avoirdupoize.*

	Hundred.		Quarters.
In	1	there is	4
	2		8
	3		12
	4		16
	5		20
	6		24
	7		28
	8		32
	9		36
	10		40

Table III. *Shewing the Number of Hundreds in* 10 *Tuns.*

	Tun.		Hund. weight.
In	1	there is	20
	2		40
	3		60
	4		80
	5		100
	6		120
	7		140
	8		160
	9		180
	10		200

By these three Tables you may readily cast up the Contents of this and all other such Sums. Table I. is for reducing the Column of Pounds into Quarters of Hundreds; Table II. reduces the Quarters of Hundreds into whole Hundreds; and Table III. reduces the Hundreds into Tuns.

Example IX. *Of Timber.*

THERE are six Pieces of Timber, number'd 1, 2, 3, 4, 5, 6.

I DEMAND *how much Timber is in all the six Pieces.*

Note, For every fifty Feet carry one to the Column of Loads.

		Loads	Feet.
Number	1 contains	2	49
	2	1	42
	3	3	16
	4	2	29
	5	4	7
	6	3	38
P.	Answer	18	31

A Table shewing the Number of Feet in ten Loads of Timber.

	Load		Feet.		Load		Feet.
In	1	there is	50	In	6	there is	300
	2		100		7		350
	3		150		8		400
	4		200		9		450
	5		250		10		500

Example X. *Of Bricks.*

A BRICKMAKER sent me in six odd Parcels of Bricks.

I DEMAND *how many Loads he sent in the Whole?*

Note, For every Five hundred in the Column of Bricks, carry 1 to the Loads.

		Load	Bricks.
In the	First Parcel he sent	1	52
	Second	2	472
	Third	1	450
	Fourth	2	270
	Fifth	3	499
	Sixth	1	429
P.	Answer	14	172

Example XI. *Of Lime.*

A LIME-MAN sent me in five Parcels of Lime, at different times.

I DEMAND *how much in the Whole?*

		Hund.	Bags.
At the	First time he sent me	3	20
	Second	1	18
	Third	4	24
	Fourth	2	19
	Fifth	4	17
P.	Answer	17	23

Note, For every 25 in the Column of [illegible]s, carry one to the Place of Hundreds.

A

A Table shewing the Number of Baggs, or Bushels in Ten hundred of Lime.

	Hund.		Baggs.		Hund.		Baggs.
In	1	there is	25	In	6	there is	150
	2		50		7		175
	3		75		8		200
	4		100		9		225
	5		125		10		250

Example XII. *Of Sand.*

I HAVE receiv'd seven Parcels of Sand.

I DEMAND *how much I have receiv'd in all?*

		Load	Bushels.
At the	First time I receiv'd	21	17
	Second	10	12
	Third	15	10
	Fourth	12	9
	Fifth	7	8
	Sixth	8	7
	Seven	9	16
P.	Answer	86	07

Note, For every 18 in the Column of Bushels, carry 1 to the Column of Loads.

A Table shewing the Number of Bushels in 10 *Loads of Sand.*

	Load		Bushels.		Load		Bushels.
In	1	there is	18	In	6	there is	108
	2		36		7		126
	3		54		8		144
	4		72		9		162
	5		90		10		180

Example XIII. *Of Land.*

A GENTLEMAN has five Parcels of Land to let out on Lease for to build on.

I DEMAND *how much Land is contain'd in all the five Parcels?*

		Acres.	Rod.	Pole.	Feet.
In the	First Parcel there is	11	3	30	250
	Second	5	1	27	150
	Third	4	2	39	271
	Fourth	3	3	18	001
	Fifth	7	3	16	101
P.	Answer	33	3	12	229

Note, That for every 272¼ contain'd in the Column of Feet, you carry 1 to the Column of Poles; and for every 40, in the Column of Poles, you carry 1 to the Column of Rods; and for every 4 in the Column of Rods, you carry 1 to the Column of Acres, which you add up as Integers.

Table I. *Shewing the Number of ſquare Feet in ten ſquare Rods or Poles of Land.*

	Rod.		Feet.		Rod.		Feet.
In	1	there is	272 ¼	In	6	there is	1633 ½
	2		544 ½		7		1905 ¾
	3		816 ¾		8		2178
	4		1089		9		2450 ¼
	5		1361 ¼		10		2722 ½

Table II. *Shewing the Number of ſquare Poles in ten ſquare Roods of Land.*

	Rood.		Poles.
In	1	there is	40
	2		80
	3		120
	4		160
	5		200
	6		240
	7		280
	8		320
	9		360
	10		400

Table III. *Shewing the Number of ſquare Roods in ten Acres of Land.*

	Acres.		Roods.
In	1	there is	4
	2		8
	3		12
	4		16
	5		20
	6		24
	7		28
	8		32
	9		36
	10		40

Example. XIV. *Of Flooring.*

A CARPENTER has laid ſix Floors.

I DEMAND *how many Square of Flooring is the Whole* ?

		Squares.	Feet.
In the	Firſt there is	3	99
	Second	5	69
	Third	4	70
	Fourth	2	81
	Fifth	7	96
	Sixth	9	25
P.	Anſwer	34	40

Note, For every Hundred in the Column of Feet, carry 1 to the Column of Squares.

A Table ſhewing the Number of ſquare Feet in ten Squares of Work.

	Square.		Feet.		Square.		Feet.
In	1	there is	100	In	6	there is	600
	2		200		7		700
	3		300		8		800
	4		400		9		900
	5		500		10		1000

Example

Example XV. *Of Gilding.*

A PAINTER has gilded over five square Pieces of Work.

I DEMAND *the Number of square Feet contain'd in all the five Pieces of Gilding?*

In the		Squ.Feet.	Squ.Inches.
	First there is contain'd	5	143
	Second	9	72
	Third	6	16
	Fourth	4	131
	Fifth	5	141
P.	Answer	32	071

Note, For every 144 in the Column of square Inches, carry 1 to the Column of square Feet.

A Table shewing the Number of square Inches in ten square Feet.

	Squ.Feet.		Squ.Inch.		Squ.Feet.		Squ.Inch.
In	1	there is	144	In	6	there is	864
	2		288		7		1008
	3		432		8		1152
	4		576		9		1296
	5		720		10		1440

Example XVI. *Of Painting.*

A PAINTER has colour'd over five Pieces of Wainscoting.

I DEMAND *how many Yards in the Whole?*

In the		Yards.	Feet.
	First Piece there is	27	8
	Second	18	7
	Third	14	8
	Fourth	16	3
	Fifth	15	5
P.	Answer	93	4

Note, That for every 9 in the Column of Feet, you carry 1 to the Column of Yards.

A Table shewing the Number of square Feet in ten square Yards

	Yards.		Feet.		Yards.		Feet.
In	1	there is	9	In	6	there is	54
	2		18		7		63
	3		27		8		72
	4		36		9		81
	5		45		10		90

Example XVII. *Of Solid Yards.*

A LABOURER agreed to dig and carry out Earth required to make a Cellar, which he performed in six Days.

I DEMAND *the whole Quantity taken out of the Cellar?*

In the		Cub.Y.	Cub.F.
	First Day he dug out	3	26
	Second	2	21
	Third	4	17
	Fourth	3	18
	Fifth	2	24
	Sixth	1	20
P.	Answer	19	18

Note, That for every 27 in the Column of Cubical Feet, you carry one to the Column of Cubical Yards.

A Table shewing the Number of Cubical Feet in ten Cubical Yards.

Yards.		Feet.	Yards.		Feet.
In 1	there is	27	In 6	there is	162
2		54	7		189
3		81	8		216
4		108	9		243
5		135	10		270

Example XVIII.

On the Tenth Day of *March*, and Eleventh Day of *September*, the *Sun* is in the *Æquinoctial Circle*, which is 360 Degrees in Circumference, and passes 15 Degrees in every Hour.

	Deg.	Min.
Now the Question is; Suppose that from Six in the Morning, being the Time of her Rising, unto 7, there passes	15	0
And from 7 to ¼ after 8	26	15
And from thence to 9	3	45
And from thence to ½ an Hour after 9	7	30
And from thence to 10	7	30
And from thence to ½ an Hour after 11	22	30
And from thence to 12 at Noon	7	30
And from thence to 3 in the Afternoon	45	00
And from thence to ¼ after 4	26	15
And from thence to 6 at Night, the Time of Setting	18	45
I DEMAND *how many* Degrees *are passed in the Time?* P. Answer	180	00

Note, That for every 60 in the Column of Minutes, carry one to the Degrees.

A Table shewing the Number of Minutes in 10 *Degrees.*

Deg.		Min.	Deg.		Min.
In 1	there is	60	In 6	there is	360
2		120	7		420
3		180	8		480
4		240	9		540
5		300	10		600

Note, *That* 60 *Minutes, or Miles, make* 1 *Degree of Measure, as* 60 *Minutes make* 1 *Hour of Time.*

Thus have I given you a great Variety of Examples for Practice; and here I must observe to you, that if you find any among them too hard to perform for want of knowing Subtraction, pass them over, and when you have learn'd the following Rule of Subtraction, return back to them again, and you'll perform them with Pleasure. Note, *I must also observe to you, that as all the foregoing Tables are generally useful for your expeditious casting up the Contents of all Kinds of Quantities, I would advise you to compose them in a handsome Manner on a Sheet of Paper pasted on Past-board, and place them in your Study or Accompting-house, for Use, when required.*

LECTURE

LECTURE III.

Of SUBTRACTION.

P. WHAT *is to be underſtood by Subtraction?*

M. SUBTRACTION is the third Rule of Arithmetick, and teaches to find the Difference of any two Numbers, by taking or drawing the Leſſer from the Greater, whereby the Difference will appear; which Difference is called the Exceſs, or Remainder.

P. PRAY *what is to be obſerved particularly herein?*

M. THAT the leſſer Number be always ſet down under the greater, as in Addition, taking Care to *place Units under Units, Tens under Tens*, &c. and then draw a Line underneath. As for Example: Let it be required to ſubtract 54 from 88. Then place them as in the Margin.

TO perform this Queſtion, the Numbers being placed as aforeſaid, begin at the Right Hand, and ſay, 4 from 8, and there remains 4, and 5 from 8, and there remains 3; ſo will the remains be 34; and draw a Line thus:

Example I.

88 the greateſt
54 the ſmalleſt
——
34 remains.

BEGIN at the Right Hand, and ſay, 3 from 7, and there remains 4; and 5 from 8, there remains 3; and 4 from 9, there remains 5: So will the remains be 534.

Example II.

From	- -	987
Take	- -	453
Remains	- -	534

BEGIN at the Right Hand, and ſay, 5 from 6, and there remains 1; and 5 from 7, there remains 2; and 2 from 8, there remains 6; and 4 from 9, there remains 5: So will the remains be 5621.

Example III.

From	- -	9876
Take	- -	4255
		5621

IN this Example, the upper Line conſiſting of Cyphers only, the firſt Figure excepted, we muſt borrow 10, or ſuppoſe that 10 be in the Place of the firſt Cypher, and then ſay, 5 from 0 I cannot, but 5 from 10, and there remains 5; then go on, ſaying, 1 I borrow'd, and 4 is 5, from 10, and there remains 5; then again, 1 I borrow'd, and 3 is 4, from 10, and there remains 6; then 1 I borrow'd, and 2 is 3, from 10, reſts 7: Laſtly, 1 I borrow'd, and 1 is 2, from 10, and remains 8: So will the remains be 87655.

Example IV.

From	- -	100000
Take	- -	12345
		87655

NOW, by this laſt Example you ſee, that whenever you cannot find your lower Figure in the higher, that then you are obliged to borrow Ten from the next Figure, which you conſider but as 1, when you repay it or carry it forward again, and the Reaſon why 10 ſo borrowed is accounted but 1, is this: That whereas 10 in the Place of Units is but equal to 1 in the Place of Tens, therefore every ſuch 10 ſo borrowed, is conſidered but as 1.

I WILL *make this yet more easy by another Example.*

Example V.

From	-	9227452
Take	-	345564
Rest	-	8881888

BEGIN at the Right Hand, and say, 4 from 2 I cannot, but borrowing 10 and adding to it, makes the 2, 12; then I say, 4 from 12, rest 8; then 1 I borrow'd, and 6 is 7, from 5 I cannot, but (borrowing 10) 7 from 15, rest 8: Again, 1 I borrow'd, and 5 is 6, from 4 I cannot, but (borrowing 10) 6 from 14, rests 8: Again, 1 I borrowed, and 5 is 6, from 7 rest 1: Again, 4 from 2 I cannot, but (borrowing 10) 4 from 12, rests 8: Again, 1 I borrowed, and 3 is 4, from 2 I cannot, but (borrowing 10) 4 from 12, rests 8. Lastly, the last 1 borrowed being taken from 9, rests 8. So will the Remains be 8881888.

P. I UNDERSTAND *you very well: But how shall I prove my Work, that I may know when I am right.*

M. I HAVE already told you, *that the Whole is equal to all its Parts taken together.* Therefore, *to prove your Subtraction*, add the Sum to be subtracted; (that is, the lesser or lowermost) Sum to the remainder; and if the Total is equal to the greatest or upper Number from which you were to subtract, your Work is true, otherwise 'tis false.

As for Example.

ADD together the Sum to be subtracted, mark'd B, and Remainder C, and if their Total D be equal to the greatest Number A, from which Subtraction is made, the Work is true.

9 2 2 7 4 5 2	A
3 4 5 5 6 4	B
8 8 8 1 8 8 8	C
9 2 2 7 4 5 2	D

P. I APPREHEND *you plainly, I see 'tis very reasonable and easy. Pray give me some Examples for further Practice.*

M. I WILL.

Example I.

I borrowed at divers Times - - - -	227243	Bricks.
I have paid in Part by several Payments - -	115362	
Remains due - - - - -	111881	

Example II.

I have lent at divers Times - -	99724382911	Ten Foot Deals.
I have received in Part thereof - -	87543429540	
Remains yet due to me - - -	12180953371	

Example III.

From - - - -	9999988888777776666655554422233322557119
Take - - - -	8989898989878787876767656543221275463007
Remains - - -	1010089898898988789887897879012047094112
Proof - - - -	9999988888777776666655554422233322557119

Example

Example IV.

I HAVE lent a Friend divers Parcels of Money;		My Friend has paid me;	
	l.		l.
At one time I lent him	743217	at one time - - -	621325
at another time - -	954321	at another time -	743216
at another - - -	74312	at another - - -	3210
at another - - - -	612	at another - -	520
at another - - -	810		
Lent in all - -	1773272	Received in all -	1368271

IN this Example, I firſt add all the Sums lent into one Sum, and alſo what was paid.

	l.
Then the whole Money lent is - - - -	1773272
And the whole Money paid me in Part is -	1368271
So there remains to pay - - -	0405001

THESE Examples are ſufficient for Numbers or Quantities of one Denomination; and therefore I ſhall now proceed to ſhew you

The Subtraction of Numbers of divers Denominations.

SUBTRACTION *of* MONEY.

Example I.	l.	s.	d.	q.	*Example* II.	l.	s.	d.	q.	*Example* III.	l.	s.	d.
Lent -	2327	19	11	1	Lent	7963	3	2	1	Lent -	572	11	8
Receiv'd in Part	1249	11	10	0	Paid	6272	19	10	3	Paid -	431	19	11
					Due	1690	3	3	2	Due -	140	11	9
Due -	1078	8	1	1	Proof	7963	3	2	1	Proof - -	572	11	8

M. THE Subtraction of Money is very little different from whole Numbers or Integers, and the Manner of placing Sums is exactly the ſame as in Addition; that is, you place Pounds under Pounds, Shillings under Shillings, Pence under Pence, and Farthings under Farthings, taking Care, that the greateſt Number of the two, be the uppermoſt; as you ſee in the three foregoing Examples.

NOW OBSERVE, *That when the Number, out of which you are to ſubtract, is leſſer than the Number to be ſubtracted; then, inſtead of borrowing* 10, *as you did in the preceding Examples, you muſt borrow ſo many as make an Unit of the next Denomination, and add to it, and then ſubtract from that Sum, and place the Remainder under the Line, as in the other Examples.* I will illuſtrate this by the three preceding Examples.

1. TO work the firſt Example, I begin at the Column of Farthings, and ſay, 0 from 1 Farthing, and there remains 1 Farthing, which I ſet down underneath the Farthings; then 10 Pence from 11 Pence, reſts 1 Penny, which I ſet

I ſet down under Pence; then 11 Shillings from 19 Shillings, reſts 8 Shillings, which I put down under Shillings; then 9 Pounds from 7 I cannot, but 9 from 17 (the Pounds being the laſt Denomination, I therefore borrow 10) reſts 8, and 5 from 12, reſts 7, and 3 from 3 reſts 0, and 1 from 2, reſts 1: So the remains is 1078 l. 8 s. 1 d. 1 q.

2. To work Example II, I begin at the Column of Farthings, and ſay, 3 Farthings from 1 Farthing, I cannot, but borrowing 4 Units from the Pence, which are equal to 1 Penny, and adding it to the 1 Farthing, makes it 5 Farthings; then I ſay, 3 Farthings from 5 Farthings, reſts 2 Farthings, which 2 Farthings I write down under Farthings; then proceeding to the Pence, I ſay, 1 that I borrowed, and 10 is 11 Pence, from 2 Pence I cannot, but borrowing 1 Shilling, or 12 Pence, from the Place of Shillings, and adding them to the 2 Pence, makes 14 Pence; then I ſay, 11 Pence from 14 Pence, reſts 3 Pence, which I write down under Pence; then proceeding to the Shillings, I ſay, 1 that I borrowed, and 19 is 20, from 3 I cannot, but borrowing 20 from the Pounds, which makes one Unit thereof, and adding it to the 3, makes 23; then I ſay, 20 from 23, reſts 3, which I ſet down under Shillings; then proceeding to the Pounds, I ſay, 1 I borrowed, and 2 is 3, from 3 reſts 0, and 7 from 16 reſts 9, and 3 from 9 reſts 6, and 6 from 7 reſt 1: So that the Remains is 1690 l. 3 s. 3 d. 2 q.

3. To work Example III, I begin at the Pence, and ſay, 11 Pence from 8 Pence I cannot, but borrowing 1 Shilling, and adding to the 8 Pence, makes it 20 Pence; then 11 from 20, reſts 9, which I place under Pence; then I proceed to the Shillings, and ſay, 1 I borrowed, and 19 is 20, from 11 I cannot, but borrowing 20, and adding it to the 11, makes it 31; then I ſay, 20 from 31, reſts 11, which I write down under Shillings; and proceeding to the Pounds, ſay, 1 I borrowed, and 1 is 2, from 2 reſt 0, and 3 from 7 reſts 4, and 4 from 5 reſt 1: So that the Remains is 140 l. 11 s. 9 d. And ſo in like Manner all others.

P. PRAY *do you prove theſe Subtractions as you did the foregoing whole Numbers?*

M. YES: By adding the ſmalleſt Number and Remainder together, as you ſee done in the Examples.

I SHALL now proceed to the Subtraction of various Things for your further Practice.

I. SUBTRACTION *of Feet and Inches.*

	Feet.	Inch.		Feet.	Inch.		Feet.	Inch.
From	123	11	From	7278	3	From	12435	0
Take	102	7	Take	6142	11	Take	7214	10
Reſt	21	4	Reſt	1135	4	Reſt	5220	2
Proof	123	11	Proof	7278	3	Proof	12435	0

In Works of this Nature, you borrow 12, when required from the Feet, and carry 1 for it; as in the Second and Third Examples.

II. SUB-

II. SUBTRACTION *of Yards, Feet, and Inches.*

	Yards.	Feet.	Inch.
From	107	2	7
Take	97	2	11
Reſt	9	2	8
Proof	107	2	7

	Yards.	Feet.	Inch.
From	2354	0	4
Take	1243	2	5
Reſt	1110	0	11
Proof	2354	0	4

	Yards.	Feet.	Inch.
From	2721	0	9
Take	123	2	10
Reſt	2597	0	11
Proof	2721	0	9

Here, when you have Occaſion, you borrow 12 from the Feet, and 3 from the Yards.

III. SUBTRACTION *of Fathoms, Yards, Feet, and Inches.*

	Fath.	Yards.	Feet.	Inches.
From	272	0	2	10
Take	261	0	2	11
Reſt	10	1	2	11
Proof	272	0	2	10

	Fath.	Yards.	Feet.	Inches.
From	5432	2	2	1
Take	4132	2	1	10
Reſt	1300	0	0	3
Proof	5432	2	2	1

Here you borrow 12 from the Feet, 3 from the Yards, and 2 from the Fathoms.

P. PRAY *Why do you borrow but two from the Fathoms, ſince that a Fathom is ſix Feet.*

M. BECAUSE that 2 Yards make 1 Fathom, as 3 Feet make 1 Yard.

IV. SUBTRACTION *of Fathoms and Feet.*

	Fath.	Feet.
From	1234	5
Take	723	4
Reſt	511	1
Proof	1234	5

	Fath.	Feet.
From	2345	1
Take	379	5
Reſt	1965	2
Proof	2345	1

	Fath.	Feet.
From	75	0
Take	72	5
Reſt	2	1
Proof	75	0

Here you borrow 6 from the Fathoms, when there is Occaſion; as in the two laſt Examples.

V. SUBTRACTION *of Rods (or Poles) and Feet.*

	Rods.	Feet.
From	299	1
Take	172	14
Reſt	126	3½
Proof	299	1

	Rods.	Feet.
From	221	7
Take	121	8
Reſt	99	15½
Proof	221	7

	Rods.	Feet.
From	427	11
Take	333	12
Reſt	93	15½
Proof	427	11

Here you borrow 16 and ½, becauſe in 1 Rod there is 16 Feet and ½.

VI. SUBTRACTION *of Chains and Links.*

	Chains.	Links.		Chains.	Links.		Chains.	Links.
From	252	91	From	772	10	From	6272	18
Take	179	95	Take	345	99	Take	5432	75
Rest	72	96	Rest	426	11	Rest	839	43
Proof	252	91	Proof	772	10	Proof	6272	18

Here you borrow 100, becauſe in 1 Chain there is 10 Links.

VII. SUBTRACTION *of Avoirdupoize Weight.*

	Tons.	Hund.	Quart.	Pounds.		Tons.	Hund.	Quart.	Pounds.
From	701	11	2	16	From	882	5	2	14
Take	602	19	3	27	Take	777	18	3	20
Reſt	98	11	2	17	Reſt	104	6	2	22
Proof	701	11	2	16	Proof	882	5	2	14

Here you borow 28 from the Quarters, 4 from the Hundreds, and 20 from the Tons, becauſe that 28 Pounds is 1 Quarter of an Hundred, 4 Quarters is 1 Hundred, and 20 Hundred is 1 Ton.

VIII. SUBTRACTION *of Timber.*

	Loads.	Feet.		Loads.	Feet.		Loads.	Feet.
From	527	25	From	723	15	From	222	32
Take	327	49	Take	527	39	Take	197	35
Reſt	199	26	Reſt	195	26	Reſt	24	47
Proof	527	25	Proof	723	15	Proof	222	32

Here you borrow 50 from the Loads, becauſe that in 1 Load of Timber there is 50 Feet.

IX. SUBTRACTION *of Bricks.*

	Loads.	Bricks.		Loads.	Bricks.		Loads.	Bricks.
From	221	472	From	325	28	From	772	101
Take	137	499	Take	279	328	Take	555	425
Reſt	83	473	Reſt	45	200	Reſt	216	176
Proof	221	472	Proof	325	28	Proof	772	101

Here you borrow 500 from the Loads, becauſe 500 Bricks is 1 Load.

X. SUBTRACTION *of Lime.*

	Hund.	Baggs.		Hund.	Baggs.		Hund.	Baggs.
From	272	18	From	777	15	From	825	11
Take	192	24	Take	555	20	Take	724	23
Reſt	79	19	Reſt	221	20	Reſt	100	13
Proof	272	18	Proof	777	15	Proof	825	11

Here you borrow 25 from the Hundreds, becauſe 25 Baggs make One Hundred of Lime.

XI. SUBTRACTION *of Sand.*

	Loads.	Bushels.		Loads.	Bushels.		Loads.	Bushels.
From	505	8	From	207	11	From	221	9
Take	407	17	Take	118	16	Take	125	11
Rest	97	9	Rest	88	13	Rest	95	16
Proof	505	8	Proof	207	11	Proof	221	9

Here you borrow 18 from the Loads, becauſe 18 Buſhels make 1 Load.

XII. SUBTRACTION *of Land-Meaſure.*

	Acres.	Roods.	Poles.	Feet.		Acres.	Roods.	Poles.	Feet.
From	1728	2	37	15	From	2237	1	27	19
Take	507	3	38	207	Take	1432	3	35	201
Reſt	1220	2	38	80¼	Reſt	804	1	31	90¼
Proof	1728	2	37	15	Proof	2237	1	27	19

Here you borrow 272 ¼ from the Poles, 40 from the Roods, and 4 from the Acres, becauſe that 272 Feet and ¼ is 1 Pole, 40 Pole is 1 Rood, and 4 Roods are 1 Acre.

XIII. SUBTRACTION *of Flooring.*

	Squares.	Feet.		Squares.	Feet.		Squares.	Feet.
From	729	75	From	5524	7	From	332	18
Take	342	80	Take	4444	95	Take	271	19
Reſt	386	95	Reſt	1079	12	Reſt	60	99
Proof	729	75	Proof	5524	7	Proof	232	18

Here you borrow 100, becauſe that 100 ſquare Feet make 1 ſquare of Flooring.

XIV. SUBTRACTION *of Gilding.*

	Squ. Feet.	Squ. Inches.		Squ. Feet.	Squ. Inches.
From	279	140	From	339	49
Take	139	143	Take	222	97
Reſt	139	141	Reſt	116	96
Proof	279	140	Proof	339	49

Here you borrow 144 from the Feet, becauſe that in 1 ſquare Foot there are 144 ſquare Inches.

XV. SUBTRACTION *of Painting.*

	Yards.	Feet.		Yards.	Feet.		Yards.	Feet.
From	218	5	From	715	5	From	729	7
Take	127	8	Take	525	8	Take	557	8
Reſt	90	6	Reſt	189	6	Reſt	171	8
Proof	218	5	Proof	715	5	Proof	729	7

Here you borrow 9 from the Yards, becauſe 9 ſquare Feet make 1 ſquare Yard.

XVI. SUBTRACTION *of Solid Yards.*

	Solid Ys.	Feet.		Solid Ys.	Feet.		Solid Ys.	Feet.
From	527	18	From	666	21	From	726	16
Take	472	19	Take	198	26	Take	517	24
Reſt	54	26	Reſt	467	22	Reſt	208	19
Proof	527	18	Proof	666	21	Proof	726	16

Here you borrow 27 from the Yards, becauſe that 27 Solid Feet make 1 Solid Yard.

XVII. SUBTRACTION *of Degrees and Minutes.*

	Deg.	Min.		Deg.	Min.		Deg.	Min.
From	926	45	From	365	20	From	24	18
Take	728	50	Take	321	59	Take	18	54
Reſt	197	55	Reſt	43	21	Reſt	5	24
Proof	926	45	Proof	365	20	Proof	24	18

Here you borrow 60 from the Degrees, becauſe that 60 Minutes make 1 Degree.

XVIII. SUBTRACTION *of Plank* 1 *Inch thick.*

Note, 600 Feet make 1 Load.

	Loads.	Feet.		Loads.	Feet.		Loads.	Feet.
From	72	527	From	672	137	From	291	11
Take	36	582	Take	492	272	Take	172	272
Reſt	35	545	Reſt	179	465	Reſt	118	339
Proof	72	527	Proof	672	137	Proof	291	11

Here you borrow 600, becauſe 600 ſquare Feet make 1 Load.

XIX. SUBTRACTION *of Plank* 1 *Inch and* ½ *thick.*

Note, 400 Feet make 1 Load.

	Loads.	Feet.		Loads.	Feet.		Loads.	Feet.
From	437	271	From	521	11	From	60	332
Take	327	311	Take	328	307	Take	57	399
Reſt	109	360	Reſt	192	104	Reſt	2	333
Proof	437	271	Proof	521	11	Proof	60	332

Here you borrow 400, becauſe 400 ſquare Feet make 1 Load.

XX. SUBTRACTION *of Plank* 2 *Inches thick.*

Note, 300 Feet make 1 Load.

	Loads.	Feet.		Loads.	Feet.		Loads.	Feet.
From	792	18	From	540	207	From	327	256
Take	672	27	Take	432	299	Take	291	270
Reſt	119	291	Reſt	107	208	Reſt	35	286
Proof	792	18	Proof	540	207	Proof	327	256

Here you borrow 300, becauſe 300 ſquare Feet make 1 Load.

XXI. SUB-

XXI. SUBTRACTION *of Plank three Inches thick.*
Note, That 200 Feet make 1 Load.

	Loads.	Feet.		Loads.	Feet.		Loads.	Feet.
From	531	105	From	123	27	From	520	79
Take	427	199	Take	102	170	Take	472	170
Reſt	103	106	Reſt	20	57	Reſt	47	109
Proof	531	105	Proof	123	27	Proof	520	79

Here you borrow 200, becauſe 200 Feet make 1 Load.

XXII. SUBTRACTION *of Plank four Inches thick.*
Note, That 150 Feet make 1 Load.

	Loads.	Feet.		Loads.	Feet.		Loads.	Feet.
From	291	140	From	111	69	From	222	87
Take	172	141	Take	104	149	Take	215	131
Reſt	118	149	Reſt	6	70	Reſt	6	106
Proof	291	140	Proof	111	69	Proof	222	87

Here you borrow 150, becauſe 150 ſquare Feet make 1 Load.

XXII. SUBTRACTION *of Time.*

I WAS Born in 1696. How many Years is my Age to this preſent Year 1732?

The preſent Year	1732
The Year Born in	1696
Anſwer -	36

THUS have I given Varieties of Queſtions that are of very great Uſe as well as entertaining in their different Natures. I ſhall now proceed to the Fourth Rule of *Arithmetick*, called MULTIPLICATION.

LECTURE IV.

Of MULTIPLICATION.

P. WHAT *is* MULTIPLICATION?

M. MULTIPLICATION is no more than a conciſe Method of adding Numbers together, and therefore may be juſtly called *Short Addition.*

P. PRAY *explain this to me.*

I WILL. Suppoſe you were to add together the following Numbers, *viz.* 6 times 12; then, according to the Rule of Addition, you ſet them, as in the Margin, and adding them up, they make 72: But to find their total Sum by Multiplication, you muſt write once 12 only, with 6, the Number of Times under it, as following:

12
12
12
12
12
12
——
72

THEN

THEN beginning with the 6, fay, 6 times 2 is 12; fet down the 2 underneath the 6, and carry 1 in your Mind for the 10, and then fay, 6 times 1 is 6, and 1 you carried is 7; then write down 7 under the 1, and it makes the 2, 72; which is equal to the total Sum of the 6 Twelves that you added together.

12
6
72

NOW from this you fee, that *Addition* and *Multiplication* are in effect the fame Things, and differ only in the Manner of their Operations, or Working.

YOU *are now to obferve*, That in Multiplication there are three Numbers that are diftinguifhed by their particular Names, which you muft well take Notice of; that is to fay, Firft, The *Multiplicand*. Secondly, The *Multiplier*. And laftly, the *Product*.

P. PRAY *explain them feparately, as I may underftand you rightly*.

M. I WILL. In the Example before-mention'd, to multiply 12 by 6, the Number 12 is the Multiplicand; the Number 6 the Multiplier; and the Number 72 is the Product; as in the Margin fignified.

12	*Multiplicand.*
6	*Multiplier.*
72	*Product.*

P. PRAY *why is the Multiplicand fo called?*

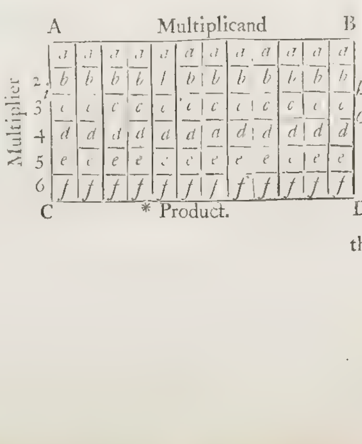
M. BECAUSE it is the Number that is to be multiplied, or added to itfelf, as many times as there are Units in the Multiplier.

P. PRAY *why is the Multiplier fo called?*

M. BECAUSE it is that Number which increafes or multiplies the Multiplicand as many times greater than itfelf, as the Number of Units contain'd therein; and as the laft Number or Product is produced by the Multiplication of the Multiplier into the Multiplicand, it is therefore call'd Product.

P. PRAY, *am I to have the fame Regard to the placing of the Figures in the Multiplicand and Multiplier, as I have in Addition and Subtraction?*

M. YES; you muft here, as before, *obferve to place Units under Units, Tens under Tens*, &c. but you are not obliged to place the greateft Number uppermoft, as you were directed to do in Subtraction; for it matters not which of the Numbers is made the Multiplicand, or which the Multiplier, for the Product is in both Cafes the fame, 12 times 6 being 72, as well as 6 times 12 is 72. But however, its more convenient to make the lefs Number the Multiplier.



THAT you may have a perfect Idea of this Rule, do you fuppofe that each of the little Squares mark'd *a*, in the Diagram, to be a fquare Foot, and let there be 12 of them ranged clofe together in a ftrait Line, a A 12 B: Now if you were to to multiply the faid 12 Feet by 2,

the

the Product would be 24; that is, to the 12 Squares mark'd *a a*, &c. there would be the Addition of the 12 other Squares *b b*, &c. making 24 Squares in the whole: Again, if you multiply the said 12 Squares by three, the Product will be 36; that is, then to the 12 Squares aforesaid, there would be the Addition of 24 other Squares, which are the Squares *b b*, &c. and *c c*, &c. making 36 Squares in the whole.

Now here you see, occularly demonstrated, that this Multiplication is no more than the Multiplicand 12, added as oftentimes as the Multipliers 2 and 3 consisted of Units; and so in like Manner, 12 multiplied by 4, produces the little Squares *a a*, &c. *b b*, &c. *c c*, &c. and *d d*, &c. making in the whole 48 Squares: And 12 multiplied by 5, produces the little Squares *a a*, &c. *b b*, &c. *c c*, &c. *dd*, &c. and *e e*, &c. making in the whole 60 Squares: Also 12 multiplied by 6, produces the little Squares *a a*, &c. *b b*, &c. *c c*, &c, *d d*, &c. *e e*, &c. and *f f*, &c. making in the whole 72 Squares, which all are comprized in the oblong square Figure marked A B C D.

Now you are to observe, That in this last Multiplication, the Side A B is the *Multiplicand*, the End A C, the *Multiplier*, and all the 72 Squares taken together, make the *Product*.

P. VERY *well, Sir: But what does the Lines* B D, *and* C D *represent.*

M. THE Lines B D and C D, are but boundary Lines, compleating the Squares, or they may be considered as A B and A C were; that is, you may make C D the Multiplicand, as we did A B; and B D may be made the Multiplier; and then in such Case, the Lines A B and A C do become boundary Lines compleating the Squares or Product in their respective Places.

P. I UNDERSTAND *you very right, and from hence I think it appears, that the Multiplicand and Multiplier, in all Questions of Multiplication, are to be considered as two Lines, the one as the Length of an oblong Square, and the other as the Breadth; and the Product the Space included within the Lines or Bounds of the Square thereof. And if I am right herein, then when the Multiplicand and the Multiplier are equal to each other; that is, when those two Lines are of the same Length, and the boundary Lines opposite to each, be the same, they together must make a Product, or Figure that is exactly square.*

M. 'TIS true; you have a right Understanding thereof, it is the Reason of Multiplication, and now the whole will become very easy. But before you proceed any farther, get the following Table by Heart.

P. I WILL. *But really, at present, I don't know how to begin.*

M. I WILL make it easy. First you see, that on the Head of the Table are placed the Numbers 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, and the like down the Left-hand Side; and the Use of this Table is to multiply those at the Head, into those at the Side, and tell their Products. As for Example: I would multiply 2 by 2, or know how much 2 times 2 make.

Multiplication TABLE.

1	2	3	4	5	6	7	8	9	10	11	12
2	4	6	8	10	12	14	16	18	20	22	24
3	6	9	12	15	18	21	24	27	30	33	36
4	8	12	16	20	24	28	32	36	40	44	48
5	10	15	20	25	30	35	40	45	50	55	60
6	12	18	24	30	36	42	48	54	60	66	72
7	14	21	28	35	42	49	56	63	70	77	84
8	16	24	32	40	48	56	64	72	80	88	96
9	18	27	36	45	54	63	72	81	90	99	108
10	20	30	40	50	60	70	80	90	100	110	120
11	22	33	44	55	66	77	88	99	110	121	132
12	24	36	48	60	72	84	96	108	120	132	144

FIRST, I find 2 in the Side of the Table, and also 2 in the Head of the Table, then in the little Square that is under the 2 at the Top, and against 2 in the Side, stands 4, which is the Product of 2 multiplied by 2.

AGAIN, I would multiply 6 by 4, or know how much 6 times 4 make. First I find 6 in the Side, and under 4 at the Top, stands 24, which is the Product of 6 multiplied by 4; and so in like Manner all other Numbers, as following:

Twice	is	Three times	is	Four times	is
2	4	2	6	2	8
3	6	3	9	3	12
4	8	4	12	4	16
5	10	5	15	5	20
6	12	6	18	6	24
7	14	7	21	7	28
8	16	8	24	8	32
9	18	9	27	9	36
10	20	10	30	10	40
11	22	11	33	11	44
12	24	12	36	12	48

Five times	is	Six times	is	Seven times	is
2	10	2	12	2	14
3	15	3	18	3	21
4	20	4	24	4	28
5	25	5	30	5	35
6	30	6	36	6	42
7	35	7	42	7	49
8	40	8	48	8	56
9	45	9	54	9	63
10	50	10	60	10	70
11	55	11	66	11	77
12	60	12	72	12	84

Eight

Eight times		is	Nine times		is	Ten times		is
	2	16		2	18		2	20
	3	24		3	27		3	30
	4	32		4	36		4	40
	5	40		5	45		5	50
	6	48		6	54		6	60
	7	56		7	63		7	70
	8	64		8	72		8	80
	9	72		9	81		9	90
	10	80		10	90		10	100
	11	88		11	99		11	110
	12	96		12	108		12	120

Eleven times		is	Twelve times		is
	2	22		2	24
	3	33		3	36
	4	44		4	48
	5	55		5	60
	6	66		6	72
	7	77		7	84
	8	88		8	96
	9	99		9	108
	10	110		10	120
	11	121		11	132
	12	132		12	144

P. SIR, *I have learn'd this Table perfectly by Heart, and can readily multiply any Numbers therein.*

M. VERY WELL: Now I will proceed to make you perfect in this Rule, so as to work any Sum that shall be stated you.

Example I.

SAY, 2 times 2 is 4, 2 times 3 is 6, 2 times 4 is 8, and 2 times 7 is 14: So the Product is 14868.

By 1 *Figure*

Multiply	7432
By	2
Product	14864

Example II.

SAY, 3 times 7 is 21, set down 1, and carry 2, for the 20, and say 3 times 2 is 6, and 2 I carry is 8, which set down under the 2; then say, 3 times 7 is 21, set down the 1, and carry 2, and say 3 times 4 is 12, and 2 I carry is 14, set down 4 and carry 1 for the Ten, and say, 3 times 9 is 27, and 1 I carry is 28, set down the 8 and carry 2; then 3 times 5 is 15, and 2 I carry is 17, which being the last, set it down under the 5: So will the Product be 1784181.

By 1 *Figure*

Multiply	594727
By	3
Product	1784181

Example III.

FIRST say, 7 times 4 is 28, set down 8 and carry 2; then 7 times 5 is 35, and 2 is 37, set down 7 and carry 3; then 7 times 3 is 21, and 3 is 24, set down 4 and carry 2; then 7 times 4 is 28, and 2 I carry is 30, set down 0, and carry 3;

By 2 *Figures*

Multiply	7724354
By	97
	54070478
	69519186
Product	749262338

then

then 7 times 2 is 14, and 3 I carry is 17, ſet down 7 and carry 1; then 7 times 7 is 49, and 1 I carry is 50, ſet down 0 and carry 5; then 7 times 7 is 49, and 5 I carry is 54, which ſet down, and ſo have you finiſh'd the Multiplication of the firſt Figure. Secondly, ſay 9 times 4 is 36, ſet down the 6 under the the 9 and carry 3; then 9 times 5 is 45, and 3 I carry is 48, ſet down 8 and carry 4; then 9 times 3 is 27, and 4 I carry is 31, ſet down 1 and carry 3; then 9 times 4 is 36, and 3 I carry is 39, ſet down 9 and carry 3; then 9 times 2 is 18, and 3 I carry is 21, ſet down 1 and carry 2; then 9 times 7 is 63, and 2 I carry is 65, ſet down 5 and carry 6; then 9 times 7 is 63, and 6 I carry is 69. Thirdly, add together the two Sums produced by the two Multipliers, and their Total 749262338 is the Product required.

Example IV.

By 3 Figures	Multiply	47325	*Multiplicand.*
	By	987	*Multiplier.*
		331275	*Produce of the Multiplier 7*
		378600	*Produce of the ſecond Multiplier 8*
		425925	*Produce of the third Multiplier 9*
	Product	46709775	*Total Sum of all the Products.*

FIRST ſay, 7 times 5 is 35, ſet down 5 under the 7 and carry 3; then ſay 7 times 2 is 14, and 3 I carry is 17, ſet down 7 and carry 1; then 7 times 3 is 21, and 1 I carry is 22, ſet down 2 and carry 2; then 7 times 7 is 49, and 2 I carry is 51, ſet down 1 and carry 5; then ſay 7 times 4 is 28, and 5 I carry is 33: ſo will the Produce of the firſt Multiplier be 331275 as above.

SECONDLY, Begin with the ſecond Multiplier 8, and ſay 8 times 5 is 40, ſet down 0 under the Multiplier 8, and carry 4; then 8 times 2 is 16, and 4 I carry is 20, ſet down 0 and carry 2; then 8 times 3 is 24, and 2 I carry is 26, ſet down 6 and carry 2; then 8 times 7 is 56, and 2 I carry is 58, ſet down 8 and carry 5; then 8 times 4 is 32, and 5 I carry is 37: ſo will the Produce of the ſecond Multiplier be 378600 as above.

THIRDLY, Begin with the third Multiplier 9, and ſay, 9 times 5 is 45, ſet down 5 under the 9, and carry 4; then 9 times 2 is 18, and 4 I carry is 22, ſet down 2, and carry 2; then 9 times 3 is 27, and 2 I carry is 29, ſet down 9, and cary 2; then 9 times 7 is 63, and 2 I carry is 65, ſet down 5, and carry 6; then ſay, 9 times 4 is 36, and 6 is 42: ſo will the Produce of the third Multiplier be 425925 as above.

FOURTHLY, Add together theſe three Products, as they ſtand in their reſpective Places, and their total Sum 46709775 is the Product required.

Example V.

Multiply		507342
By		4001
		507342
		202936800
Product		2029875342

FIRST ſay, once 2 is 2, once 4 is 4, once 3 is 3, once 7 is 7, once 0 is 0, and once 5 is 5.

SECONDLY, As the next two Multipliers are Cyphers, therefore firſt ſet them down under themſelves, and

then

then proceed to the Multiplier 4, and ſay 4 times 2 is 8, which ſet down under the 4; and 4 times 4 is 16, ſet down 6 and carry 1; then 4 times 3 is 12, and 1 I carry is 13, ſet down 3 and carry 1; then 4 times 7 is 28, and 1 I carry is 29, ſet down 9 and carry 2; and becauſe 4 times 0 is 0, therefore ſet down the 2 you carried; laſtly, 4 times 5 is 20. Now theſe two Products being added as they ſtand, their Total will be the Product required.

P. PRAY *what is the Reaſon that you place down the Cyphers in the Multiplier, and go directly to the laſt Figure* 4?

M. To contract the Work, and ſave a great deal of needleſs Labour of making two Lines of Cyphers, as you'll ſee in the Margin, where the ſame Example is work'd with the Cyphers in their Places.

507342
4001
507342
000000
000000
2029368
2029875342

P. 'TIS *true, Sir, I ſee that if I take care to place the firſt Figure produced by each Multiplier, under the ſame, that then there's no need of introducing thoſe Cyphers, and the Products will ſtand in their true Places to be added together. Pray proceed to other Examples.*

M. I WILL.

Example VI.

HERE you have a Cypher for your firſt Multiplier, which being nothing of itſelf, therefore compleat your Multiplication in the whole Numbers, and at the laſt add the Cypher to the Right Hand of the Product; ſaying, once 7 is 7, once 5 is 5, once 4 is 4, once 2 is 2, once 8 is 8, and once 3 is 3; ſo will the Produce be 382457, to which add the Cypher 0, and the Product will be 3824570.

Multiply	382457
By	10
	3824570

NOW from this you ſee that the Number 1 does not multiply of itſelf, for the Product thereof, before the Cypher was added, was the ſame as the Multiplicand; whence it follows, that if to the Multiplicand you had annexed one Cypher, that would have performed the Work without any farther Trouble: And ſo in like manner, when you are to multiply any Number by 100, 1000, 10000, &c. you have nothing more to do, than to annex as many Cyphers to the Multiplicand, as are contain'd in the Multiplier. As for

Example

Multiply	2437	Multiply	57263	Multiply	123456
By	100	By	1000	By	10000
Product	243700	Product	57263000	Product	1234560000

P. I SEE *the Reaſon plainly; but ſuppoſe that there are Cyphers at the End of both Multiplicand and Multiplier. As for*

Example.

Let the Multiplicand be	-	724000
And the Multiplier -	-	32000

M. WHEN there be Cyphers at the End of either, or both the Multiplicand and Multiplier, make the Multiplication in the whole Numbers firſt, and to their Product add as many Cyphers as are contain'd in both the Multiplicand and Multiplier. As for

Example.

1ſt. I MULTIPLY the whole Figures of the Multiplicand 724, by the whole Figures of the Multiplier 32, and they produce 23168.

2dly. SINCE that in the End of the Multiplicand there are 3 Cyphers, and as many in the End of the Multiplier, making 6 in the whole; therefore, to the aforeſaid Product 23168, I add 6 Cyphers, and then it becomes 23168000000, which is the true Product required.

```
     724000
      32000
    -------
    1448
   2172
-----------
23168000000
-----------
```

P. I THINK *that I underſtand every thing you have been pleaſed hitherto for to inſtruct me in; and from the laſt Example I conceive, that when I have many Cyphers at the End of my Multiplier only, that then it will be beſt for me to place the firſt Figure of my Multiplier next my Right Hand, under the firſt Figure of the Multiplicand, that thereby I may ſet all the Cyphers back, and need only add them to the Product at laſt. As for*

Example.

SUPPOSE *I was to multiply* 15437291, *by* 1740000, *then I would place them as in the Margin, and to the Product* 2686088634, *which is produced by the Multiplication of the Figures only, I bring down, or add, the four Cyphers ſet back belonging to the Multiplier.*

```
 15437291
      1740000
 ------------
  61749164
108061037
15437291
--------------
26860886340000
--------------
```

```
        15437291
         1740000
  --------------
  61749164
 108061037     AB
15437291
  --------------
  26860886340000
  --------------
```

M. SUMS ſo multiplied, and the Cyphers brought down will be true; but the moſt maſterly manner is to ſet your Multiplier in its Place, and perform the Multiplication with the Figures only, as at AB in the Margin, and to the Product add four Cyphers, as before ſhewn. Either of theſe Ways will do, and I muſt aſſure you, that it is with Pleaſure I inſtruct you, ſince that you delight herein, and labour hard, for to underſtand the Truth of your Works as you proceed.

P. SIR, *I will do my utmoſt, and keep cloſe to my Studies: But pray how muſt I do to prove that my Sums are truly performed, or not?*

M. THE beſt Manner of proving your Work, is to make your Multiplication prove itſelf; that is, *make that Number which was your Multiplicand, your Multiplier*, and then multiplying as uſual, *if your Product be the ſame*, you may depend upon the Truth of your Work, otherwiſe not.

THE moſt common Method to prove Multiplication, is by a Croſs, as following. Suppoſe I would prove the above Sum; firſt I make a Croſs with my Pen like the Capital X, as in the Margin of the next Page. Secondly, I ad[d] th[e]

the Figures of the Multiplicand together, without regarding their Places, but as if every Figure ſtood in the Place of Units, caſting away 9 as often as may be in the adding of them together, and the laſt Remainder, put on the left Side of the Croſs; that is, I ſay 1 and 5 is 6, and 4 is 10, then caſting away 9, there reſts 1 and 3 is 4, and 7 is 11, then rejecting 9, remains 2 and 2 is 4, and 9 is 13, then rejecting 9, remains 4 and 1 is 5; ſet down 5 on the Left Hand Side of the Croſs: And then begin with the Multiplier, ſaying, 1 and 7 is 8 and 4 is 12, then rejecting 9, there remains 3, which ſet down on the Right Hand Side of the Croſs, overagainſt the other. This done, multiply theſe two Remainders together, *viz.* 5 by 3, making 15, out of which caſt 9, and 6 remains, which ſet on the Top of the Croſs. Then, as before, caſt the nines out of the Product, ſaying, 2 and 6 is 8 and 8 is 16, rejecting 9, reſt 7 and 6 is 13, reject 9, reſt 4 and 8 is 12, reject 9 reſt 3 and 8 is 11, reject 9 reſt 2 and 6 is 8 and 3 is 11, reject 9 reſt 2 and 4 is 6, which place at the Bottom of the Croſs. Now when this laſt Remainder proves to be equal to the Remainder at the Head of the Croſs, then 'tis ſuppoſed that the Work is truly performed; tho' in many Caſes they will not be equal, altho' the Work be truly done: Wherefore I do not recommend to you this Method to prove by, but adviſe you *to prove by changing the Multiplicand into the Multiplier, as aforeſaid.*

$$\begin{array}{ccc} & 6 & \\ 5 & \times & 3 \\ & 6 & \end{array}$$

P. I SHALL *gladly receive your Advice, and in the next Place beg leave to ask you, Whether there is not a Method for to multiply Numbers without carrying on the Tens to the next Place, in the ſame Manner as you ſhew'd me how to add Numbers together without carrying on the Tens to the next Place?*

M. YES; Multiplication may be performed without any Charge to the Memory, by ſetting down the whole Product of every ſingle Figure, whereby the Carriage of the Tens will be ſaved; but the Trouble of adding them together will be greater. However, as this will be an Entertainment to you, more than really uſeful, I will ſhew you the Manner thereof, and, indeed, herein you will ſee a farther Reaſon of Multiplication.

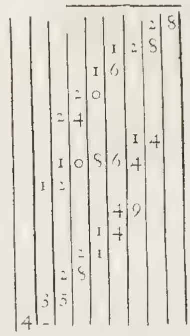
THE *Rule for working this kind of Multiplication, is as follows:*

FIRST draw from every Figure of the Multiplier, down-right Lines, between which you are to place your ſeveral Products of the Multiplier, and by help of which, you are able to keep them in their true Places.

SECONDLY, Obſerve to place the Units of the firſt Product exactly under that Figure of the Multiplier, by which you multiply; and the Tens in the next Column, under which you ſet the Units of the next Product, and advance the Tens thereof, one Column farther. This Method being duly obſerved, and thoſe ſeveral Products being added together, according to the common Way, their Total will be the true Product required.

Multiply

Multiply 6 5 4 3 2 7
By 7 2 4



Product 4 7 3 7 3 2 7 4 8

Here is the fame Sum performed the common Way, for Proof to the other.

```
 654327
    724
-------
2617308
1308654
4580289
-------
473732748
```

Example.

FIRST, I draw down the Lines as aforefaid, and then fay, 4 times 7 is 28, which fet down under the Multiplier; then fay 4 times 2 is 8, which fet down under the 2 of the 28; then fay 4 times 3 is 12, which fet down in the two next Columns, for in the laft Product 8, there was not a 10 to take up the next Column; therefore the 2 of the 12 muft be placed therein, and the 1 in the next; then 4 times 4 is 16, which fet down with the 6 under the ten of the laft Product, and the 1 in the next Column; then 4 times 5 is 20, fet the Cypher under the laft ten, and the 2 in the next Column; and laftly, 4 times 6 is 24, which fet down, placing the 4 under the 2 of the 20, and fo will the Multiplication of the firft Figure be ended.

SECONDLY, Begin with 2, the fecond Figure of the Multiplier, and fay, 2 times 7 is 14, which fet down, placing the 4 under the multiplying Figure 2, and the 1 in the next Column; then fay 2 times 2 is 4, which fet down under the 1 of the 14, as being but Units; then 2 times 3 is 6, which place in the next Column; and 2 times 4 is 8, which place in the next Column; then 2 times 5 is 10: Now as to the laft Product, there was not any tens, therefore you muft place the 0 of the 10 in the next Column, and the 1 in the next; laftly, 2 times 6 is 12, which fet down with the 2 under the 1 of the 10; and fo will the Multiplication of the fecond Figure be ended. Then begining with 7, the third Figure of the Multiplier, fay, 7 times 7 is 49, which fet down, placing the 9 under the 7, and the 4 in the next Column. This done, multiply as before, and then adding up their feveral Products into one Total, that will be the true Product required.

I WILL now proceed to the Multiplication of divers Denominations.

P. PRAY *what is to be underftood by divers Denominations?*

M. DIVERS Denominations are Integers, or whole Numbers, divided into Parts that are differently named from the Integer. As for Example.

If

IF a Penny be confidered as an Integer, or whole Number, and be divided into two equal Parts, we call them two Half-pennies, or if into four Parts, we call them Farthings, not Two Pence, or Four Pence. So in like manner, if a Foot in Length be called an Integer, or one, and we divide it into 12 equal Parts, we then call each Part an Inch, and the Whole 12 Inches, not 12 Feet. Again, If one Yard in Length, be confidered as an Integer, and is divided into three equal Parts, we call thofe Parts Feet, not Yards, altho' Parts thereof. Now from this you fee, that divers Denominations are but the Parts of an Integer differently named, and are multiplied by the following

RULE.

MULTIPLY *the leaft Denomination of the Multiplicand, by the Multiplier, and carry* 1 *to the next Denomination, for every fuch Parts that are equal to an Integer thereof.*

Example I.

	d.	q.
Multiply	11	3
By		9
Product	105	3

FIRST, Multiply the 3 Farthings by 9, faying, 9 times 3 is 27. Now fince that four Farthings are equal to one Integer of the next Denomination, which are Pence, therefore confider how many times four Farthings can be found in 27, which is 6 times and 3 remaining; therefore fet down 3 Farthings under the Farthings, and carry 6 to the next Denomination, faying, 9 times 11 is 99, and 6 I carry is 105, which fet down under the Pence; fo will the Product be 105 d. 3 q.

Example II.

	s.	d.	q.
Multiply	5	11	3
By			9
Product	53	9	3

FIRST, Multiply the 3 Farthings by 9 as before, and carry 6 to the Place of Pence, and fay, 9 times 11 is 99, and 6 is 105 Pence. Now fince that 12 Pence are equal to 1 Integer of the next Denomination of Shillings, therefore confider how many times 12 can be found in 105 d. which is 8 times and 9 remaining, therefore fet down the 9 Pence under the Pence, and carry 8 to the Column of Shillings, and fay, 9 times 5 is 45, and 8 I carry is 53, which fet down; and fo the Product will be 53 s. 9 d. 3 q.

Example III.

	l.	s.	d.	q.
Multiply	7	5	11	3
By				9
Product	65	13	9	3

FIRST, Multiply the Farthings and Pence as before, faying, 9 times 3 is 27, fet down 3 and carry 6; then 9 times 11 is 99, and 6 is 105, fet down 9 and carry 8; then 9 times 5 s. is 45, and 8 I carry is 53 s. Now fince that 20 s. are equal to 1 Integer of the next Denomination, therefore confider how many 20 s. can be found in 53 s. which is 2 times and 13 remaining; therefore fet down 13 under the Shillings, and carry 2 to the Column of Pounds, and fay, 9 times 7 is 63, and 2 I carry is 65, which fet down under the Pounds, and the Product will be 65 l. 13 s. 9 d. 3 q.

[S]UMS of this Nature may be began with their greateft Denomination, and ended with the fmalleft, contrary to the foregoing Examples. As fo[llows].

Example I.

FIRST, Say 9 times 11 Pence is 99 Pence, which set down under Pence; then say 9 times 3 Farthings is 27 Farthings, equal to 6 Pence 3 Farthings, set down 6 under the Pence, and 3 under the Farthings, and add them together, and their Sum is 105 Pence 3 Farthings.

	d.	q.
Multiply	11	3
By	9	
	99	
	6	3
Product	105	3

Example II.

FIRST, Say 9 times 5 Shillings is 45 Shillings, which set down under the Shillings. Secondly, Say 9 times 11 Pence is 99 Pence, equal to 8 Shillings and 3 Pence, set down the 8 under the Shillings, and the 3 under the Pence. Thirdly, Say 9 times 3 Farthings is 27 Farthings, equal to 6 Pence 3 Farthings, set down the 6 under the Pence, and the 3 under the Farthings, then add them up, and the Product will be 53 Shillings 9 Pence 3 Farthings.

	s.	d.	q.
Multiply	5	11	3
By	9		
	45		
	8	3	
		6	3
Product	53	9	3

Example III.

FIRST, Say 9 times 7 is 63, which set down under the Pounds; then say 9 times 5 Shillings is 45 Shillings, equal to 2 Pounds 5 Shillings, set down the 2 under the Pounds and the 5 under the Shillings; then say 9 times 11 Pence is 99 Pence, equal to 8 Shillings 3 Pence, which set down, the 8 under the Shillings, and the 3 under the Pence; then say 9 times 3 Farthings is 27 Farthings, equal to 6 Pence 3 Farthings, which set down, the 6 under the Pence, and the 3 under the Farthings; then adding the whole together, the Total, or Product, will be 65 Pounds 13 Shillings 9 Pence 3 Farthings.

	l.	s.	d.	q.
Multiply	7	5	11	3
By	9			
	63			
	2	5		
		8	3	
			6	3
Product	65	13	09	3

Example IV.

FIRST, Multiply the Pounds into themselves, saying, 5 times 3 is 15, 5 and go 1; and 5 times 6 is 30, and 1 I carry is 31, which set down; then say 4 times 3 is 12, 2 and go 1, and 4 times 6 is 24, and 1 I carry is 25, which set down under the Pounds, as in the Margin. Secondly, This done, multiply the Shillings, and say first, 45 times 10 Shillings is 22 Pounds 10 Shillings, which set down, the Pounds under Pounds, and Shillings under Shillings; and then 45 times 4 Shillings is 180 Shillings, equal to 9 Pounds, which set down under the Pounds. Thirdly, Say 45 times Eleven Pence is 45 Shillings wanting 45 Pence,

	l.	s.	d.	q.
Multiply	63	14	11	2
By	45			
	315			
	252			
	22	10		
	9	0		
	2	1	3	
		1	10	2
Product	2868	13	1	2

45 Pence, *viz.* 3 Shillings and 9 Pence, out of 45 Shillings, refts 41 Shillings 3 Pence, equal to 2 Pounds 1 Shilling 3 Pence, which fet down in their refpective Places. Fourthly, 45 Half-pence is 1 Shilling 10 Pence ½ Penny, which fet down under Shillings, Pence and Farthings. Laftly, Add together the Whole, and the Total will be the Product required.

NOTE, That the 14 Shillings might have been multiplied at once, faying 45 times 14 Shillings is 630 Shillings, equal to 31 Pounds 10 Shillings; but as you don't yet know how to divide 630 Shillings by 20, I therefore recommend the foregoing Method; and, indeed, even when you have learn'd DIVISION, you will find it much the moft expeditious, and eafy Method.

NOW you are to obferve in the laft Example; That in the firft Part thereof, Pounds multiplied by Pounds (that is to fay, 63 Pounds by 45 Pounds) the Produce is Pounds. That Pounds multiplied by Shillings (that is to fay, 45 Pounds by 14 Shillings) every 20 is one Pound, the reft Shillings: So herein the Produce of 45 times 14 Shillings is 630 Shillings, wherein 20 is contained 31 times, and 10 remains, which is 31 Pounds 10 Shillings. That Pounds multiplied by Pence (that is to fay, 45 Pounds by 11 Pence) every 12 is one Shilling, the reft Pence; fo herein the Produce of 45 times 11 Pence, is 495 Pence, containing Twelve 41 times, and 3 remaining, which is 2 Pounds 1 Shilling 3 Pence. That Pounds multiplied by Farthings (that is to fay, 45 Pounds by 2 Farthings) every 4 is one Penny, the reft Farthings; fo herein the Produce of 45 times 2 Farthings is 90 Farthings, containing Four 22 times, equal to 22 Pence and 2 Farthings, or 1 Shilling 10 Pence Half-penny.

I SHALL, in the next Place, fhew you how to perform Multiplication when the Multiplicand and Multiplier do both confift of unlike Denominations, fuch as Feet and Inches, by Feet and Inches, &c.

Example I.

	Feet.	Inches.
Multiply	3	6
	X	
By	2	6
	6	
	2	6
		3
	8	9

FIRST, 2 Feet by 3 Feet is 6 Feet, which fet down under Feet. Secondly, Multiply crofs ways, the Feet into the Inches, faying 2 times 6 Inches is 12 Inches, and 3 times 6 Inches is 18 Inches. Now 18 and 12 is 30, out of which take 12 as often as you can, which in this Example is twice, and 6 remains, fet down 2 for the 2 times 12, being Feet, under the Feet, and the 6, being Inches, under the Inches. Thirdly, Multiply the Inches into themfelves, *viz.* 6 by 6, and their Product is 36, wherein 12 is contained three times, and 0 remains, therefore place the 3, being Inches, under the Inches, and then adding them together, their Product will be 8 Feet 9 Inches.

NOW you muft obferve in all Examples of this kind; That Feet multiplied by Feet, produce Feet. That Feet multiplied into Inches (as the above 2 Feet into the 6 Inches, or the 3 Feet into the 6 Inches) every 12 is a Foot, the reft Inches. That Inches multiplied into Inches, every 12 is an Inch, and each 3 a Quarter of an Inch.

P. PRAY

P. *Pray, why is every 12 a Foot, or Inch, &c.*

M. THE Reafon why you muft divide your Multiplication by 12 as you go thro' the feveral Parts, is at this Time too intricate for your Underftanding, fince that it is demonftrated by Geometry, of which you are now ignorant; I muft therefore defer to fhew you the Reafon until you are inftructed therein: But that you may be perfect in the Practice, I will further illuftrate it by more Examples; for by this kind of Multiplication, moft Parts of Buildings are meafured; and with refpect to the Method of multiplying the Feet into the Inches crofs ways. It is therefore called,

CROSS MULTIPLICATION.

Example I.

FIRST, Multiply the Feet into themfelves.

SECONDLY, Multiply 15, the Multiplier, crofs ways into 11 Inches in the Multiplicand, faying, 15 times 11, or rather divide the 11 Inches as following, faying 15 Halves, or Six's is 7 Feet 6 Inches, which fet down, and 15 Quarters, or 3 Inches, is 3 Feet 9 Inches, which fet down; and laftly, 15 Two's is 30, equal to 2 Feet and 6 Inches, which fet down, as at A B C.

THIRDLY, Multiply 27, the Multiplicand, crofs ways into 10 Inches of the Multiplier, faying 27 Halves, or Six's, is 13 Feet 6 Inches, which fet down; and 27 Quarters, or Three's, is 6 Feet 9 Inches; and 27 One's is 2 Feet 3 Inches, which fet down as at D E F.

	Feet.	Inches.		
Multiply	27	11		
	X			
By	15	10		
	135			
	27			
	7	6		A
	3	9		B
	2	6		C
	13	6		D
	6	9		E
	2	3		F
		9	2	G
	432	0	2	

FOURTHLY, Multiply the Inches into themfelves, faying 10 times 11 is 110, containing Twelve 9 times, and 2 remaining, which fet down as at G.

LASTLY, Add up the Inches, carrying 1 for every 12 to the Feet, and add up the Feet as Integers; their Total will be the Product required.

Example II.

BEFORE I proceed to this Example, I muft advertife you,

FIRST, That Feet multiplied into Quarters of Inches, each one of the Product is a Quarter of an Inch fquare, and therefore every 4 of them is one fquare Inch; and every 12 of fuch fquare Inches is to be deem'd but 1 long Inch, or one of thofe Inches in the middle Column, of which 12 makes one fquare Foot. The Reafons for which hereafter in its Place.

SECONDLY, Inches multiplied into Quarters, each 12 is 1 Quarter, and every 3 is a Quarter of a Quarter, or One fixteenth Part of an Inch.

THIRDLY, Quarters multiplied into Quarters, each 12 is a Quarter of a Quarter, or One fixteenth Part of an Inch.

THIS

THIS *I will make plain to you by the Operation of the preſent Example.*

	Feet.	Inch.	Quart.		
Multiply	37	7	3		
		X	X		
By	29	11	2		
	333				
	74				
	14	6			
	2	5			
	18	6			
	9	3			
	3	1			
	6	2			
		6	5		
		1	9	3	A
		1	6	2	B
			2	9	C
			1	2	D
			0	6	E
Product	1061	10	9	10	

FIRST, Multiply the Feet into themſelves, and ſet down their Product.

SECONDLY, Multiply 29, the Multiplier, croſs ways into 7 Inches of the Multiplicand, ſaying 29 Halves is 14 Feet 6 Inches, which ſet down under Feet and Inches, and 29 ones is 2 Feet 5 Inches; ſet theſe down as before.

THIRDLY, Multiply 37 Feet in the Multiplicand, into 11 Inches in the Multiplier, ſaying 37 Halves is 18 Feet 6 Inches, and 37 Quarters is 9 Feet 3 Inches, and 37 two Inches, equal to 74 Inches, equal to 6 Feet 2 Inches; ſet all theſe down under Feet and Inches, either ſeverally as you multiply them, or in one Sum, adding them all three together. In the Example I have ſet them down ſeverally, but in Practice you may do as you pleaſe.

FOURTHLY, Multiply 11 Inches, the Multiplier, into 7 Inches in the Multiplicand, and their Product is 77 Inches, containing Twelve 6 times, and 5 remaining: Therefore ſet down 6 Inches 5 Parts under Inches and Parts.

FIFTHLY, Multiply 29, the Multiplier, into 3, the Quarters, and their Product is 87, which, as I told you before, are each Quarters of an Inch ſquare; therefore every 4 of them is but 1 ſquare Inch, and in 87 there is 21 of thoſe Inches, and 3 remaining. Now, as I told you, that 12 of thoſe ſquare Inches made but 1 Inch in the Column of Inches; therefore take once 12 out of the 21, and ſet that down under the Inches, with the Remainder 9 under the Parts, and the firſt remaining 3 ſquare Quarters of an Inch in another Column next the Right-hand, as at A.

SIXTHLY, In the ſame Manner multiply croſs ways the 37 of the Multiplicand, into the 2 Quarters of the Multiplier, ſaying 37 times 2 is 74, containing Four 18 times, in which 12 is once, and reſt 6: Therefore ſet down 1 under the Inches, 6 under the Parts, and 2 in the laſt Column, as at B.

SEVENTHLY, Multiply 11 Inches, the Multiplier, croſs ways into 3 Quarters in the Multiplicand, and they produce 33; and, as I told you, that each 12 is a quarter of an Inch; therefore twice 12 from thence reſts 9, ſet 2 under the Quarters, and 9 in the next Column, as at C.

EIGHTHLY, Multiply 7 Inches, the Multiplicand, croſs ways into 2 Quarters in the Multiplier, and they produce 14, which is 1 Quarter 2 Parts, as at D.

LASTLY, Multiply 2 Quarters into 3 Quarters, equal to 6, which place down in the laſt Column, as at E; and then adding up every Column, carry

P 1 for

1 for every 12 from the Quarters to the Inches, and from the Inches to the Feet, their Total will be the Product required.

I SHALL now give you divers Queſtions for your further Practice; as following:

QUESTION I. *In 57234 Pence, how many Farthings?*

RULE. Becauſe that 4 Farthings make 1 Penny, you muſt therefore multiply the given Number by 4, as in the Margin.

	57234
	4
Anſw.	228936

Q. II. *In 792435 Shillings, how many Pence?*

RULE. Multiply the given Number by 12; becauſe 12 Pence is 1 Shilling.

	792435
	12
Anſw.	9509220

TO *multiply Numbers of this Kind, where the Multiplier conſiſts but of two Figures, 'tis beſt to make the upper Number the Multiplier, and the lower the Multiplicand, as follows; ſay 5 times* 12 *is* 60, *ſet down* 0, *and carry* 6; *then* 3 *times* 12 *is* 36, *and* 6 *I carry is* 42, *ſet down* 2, *and carry* 4; *then* 4 *times* 12 *is* 48, *and* 4 *I carry is* 52, *ſet down* 2 *and carry* 5; *then* 2 *times* 12 *is* 24, *and* 5 *I carry is* 29, *ſet down* 9 *and carry* 2; *then* 9 *times* 12 *is* 108, *and* 2 *I carry is* 110, *ſet down* 0, *and carry* 11; *then* 7 *times* 12 *is* 84, *and* 11 *I carry is* 95, *which ſet down: And ſo will the Product be* 9509220, *the true Product required.*

Q. III. *In 755367 Pounds, how many Shillings?*

RULE. Becauſe 20 Shillings is 1 Pound, therefore multiply the given Number by 20.

	755367
	20
Anſw.	15107340

Q. IV. *In 5274 Feet, how many Inches?*

RULE. Becauſe 12 Inches make 1 Foot, therefore multiply the given Number by 12.

	5274
	12
Anſw.	63288

Q. V. *In 72345 Yards, how many Feet?*

RULE. Becauſe 3 Feet make 1 Yard, therefore multiply the given Number by 3.

	72345
	3
Anſw.	217035

Q. VI. *In 57243 Fathoms, how many Feet?*

RULE. Becauſe 6 Feet make 1 Fathom, therefore multiply the given Number by 6.

	57243
	6
Anſw.	343458

Q. VII. *In 57928 Rods or Poles, how many Feet?*

RULE. Becauſe 16 Feet and ½ make 1 Rod or Pole, therefore multiply the given Number by 16 ½.

	57928
	16½
	926848
	28964
Anſw.	955812

Note,

Note, That to multiply the Multiplicand into the ½, you need only halve the Multiplicand, beginning with the first Figure next the Left Hand, *viz.* 5; and say half 5 is 2, which set down under the 5, and carry on the odd 1 to the 7, and say half 17 is 8, set down 8, and carry on the odd 1 to the 9, and say half 19 is 9, set 9 under the 9, and carry on the odd 1 to the 2, and say half 12 is 6, set down 6 under the 2, and then say half 8 is 4, which set down under the 8.

THUS will you have finished the Multiplication of the ½ or 6 Inches, and their Total being added, will be the Product required.

Q. VIII. *In 57492 Chains, how many Links?*

RULE. Because 100 Links is contained in 1 Chain, therefore multiply the given Number by 100.

	57492
	100
Answ.	5749200

Q. IX. *In 792927 Hundreds Avoirdupoize Weight, how many Pounds?*

RULE. Because 112 Pounds make one Hundred, therefore multiply the given Number by 112.

	792927
	112
	9515124
	792927
Answ.	88807824

Q. X. *In 275432 Tons Weight, how many Hundred?*

RULE. Because 20 Hundreds make 1 Ton, therefore multiply the given Number by 20.

	275432
	20
Answ.	5508640

Q. XI. *In 72597 Loads of Timber, how many Solid Feet?*

RULE. Because 50 Solid Feet make 1 Load of Timber, therefore multiply the given Number by 50.

	72597
	50
Answ.	3629850

Q. XII. *In 75924 Loads of Bricks, how many Bricks?*

RULE. Because that 500 Bricks are 1 Load, therefore multiply the given Number by 500.

	75924
	500
Answ.	37962000

Q. XIII. *In 72431 Hundred of Lime, how many Baggs?*

RULE. Because that 1 Hundred of Lime contains 25 Baggs, therefore multiply the given Number by 25.

	72431
	25
Answ.	1810775

Q. XIV. *In 51243 Loads of Sand, how many Bushels?*

RULE. Because that 18 Bushels make 1 Load of Sand, therefore multiply the given Number by 18.

	51243
	18
Answ.	922374

Q. XV.

Q. XV. *In 79925 ſquare Feet, how many ſquare Inches?*

	79925
	144
	319700
	1128950
	113214700

RULE. Becauſe that 144 ſquare Inches make 1 ſquare Foot, therefore multiply the given Number by 144.

Note, That whereas it may be too hard for you to multiply the 2 firſt Figures of the Multiplier 44, at once, therefore, firſt multiply by the firſt Figure 4, and afterwards the other two, *viz.* 14 by the Multiplicand, as directed in Queſtion II; then add them together, and the Total will be the Product required.

Q. XVI. *In 99723 ſquare Yards, how many ſquare Feet?*

	99723
	9
Anſw.	897507

RULE. Becauſe that 9 ſquare Feet make 1 ſquare Yard, therefore multiply the given Number by 9.

Q. XVII. *In 57259 Squares of Tiling, how many ſquare Feet?*

	57259
	100
Anſw.	5725900

RULE. Becauſe that 100 ſquare Feet make one Square of Work, therefore multiply the given Number by 100.

Q. XVIII. *In 84327 ſquare Rods or Poles, how many ſquare Feet?*

	84327
	272¼
	168654
	590289
	168654
	21081¾
Anſw.	22958028¾

RULE. Becauſe that 1 ſquare Rod contains 272 Feet and ¼, therefore multiply the given Number by 272¼.

TO multiply the Multiplicand 84327 into the ¼ of a Foot, you muſt firſt write down on a Piece of waſte Paper the Multiplicand; as at A in the Margin, then halve it, as taught in Queſtion VII, which will be the Number 42163½, as at B; then halve this Number again, as at C, which will be a quarter Part, and is the Product of 84327 multiplied by ¼, which you muſt add to the other Products, and the Total will be the Product required.

A	84327
B	42163½
C	21081¾

Q. XIX. *In 72432 ſolid Yards, how many ſolid Feet?*

	72432
	27
Anſw.	1955664

RULE. Becauſe that 1 ſolid Yard contains 27 ſolid Feet, therefore multiply the given Number by 27.

Q. XX. *In 360 Degrees, how many Minutes?*

	360
	60
Anſw.	21600

RULE. Becauſe that in 1 Degree there is 60 Minutes, therefore multiply the given Number by 60.

Q. XXI. *In 5732 Loads of 1 Inch Plank, how many Feet?*

RULE. Becauſe that 600 Feet of 1 Inch Plank make 1 Load, therefore multiply the given Number by 600.

	5732
	600
Anſw.	3439200

Q. XXII. *In 79425 Loads of Plank 1 Inch and ½ thick, how many Feet?*

RULE. Becauſe that 400 Feet of 1 Inch and ½ thick Plank make 1 Load, therefore multiply the given Number by 400.

	79425
	400
Anſw.	31770000

Q. XXIII. *In 5342 Loads of 2 Inch Plank, how many Feet?*

RULE. Becauſe that 300 Feet of 2 Inch Plank make 1 Load, therefore multiply the given Number by 300.

	5342
	300
Anſw.	1602600

Q. XXIV. *In 7723 Loads of 3 Inch Plank, how many Feet?*

RULE. Becauſe that 200 Feet of 3 Inch Plank make 1 Load, therefore multiply the given Number by 200.

	7723
	200
Anſw.	1544600

Q. XXV. *In 9972 Loads of 4 Inch Plank, how many Feet?*

RULE. Becauſe that 150 Feet of 4 Inch Plank make 1 Load, therefore multiply the given Number by 150.

	9972
	150
Anſw.	149580

THUS have I given you a large Variety of Examples and Queſtions, which being well underſtood, we may proceed to DIVISION.

LECTURE V.

Of DIVISION.

P. WHAT *is* DIVISION?

M. DIVISION is in effect no more than Subtraction, by which we diſcover how often one Number is contained in another: For was we to ſubtract one Number out of another as often times as we can find it therein, we ſhould perform that Work which is called DIVISION. As for Example: Suppoſe I was to find how often 3 is contain'd in 15 by Subtraction; then

I place my Numbers as in the Margin, and proceed as following: Saying, 3 from 15 rest 12, which is one time 3; then 3 from 12 rest 9, which is twice 3; then 3 from 9 rest 6, which is three times 3; then 3 from 6 rest 3, which is four times 3, and the remaining 3 is 5 times 3; so from hence it appears, that 3 is contain'd 5 times in 15, and 0 remains.

15	
3	once
12	
3	twice
9	
3	thrice
6	
3	fourth
3	five times

BUT seeing that this Way by Subtraction requires, much Time and Trouble in the several Subtractions, therefore a more concise Manner of working the same Effect, has been invented, which is called *Division*, wherein there are three principal Parts to be observed; that is to say,

FIRST, The given Number that is to be divided by some other Number, which is therefore called the *Dividend*.

SECONDLY, The Number by which we divide the Dividend, or seek how often it is contain'd therein, which is therefore called the *Divisor*. And,

THIRDLY, The Number expressing how often, the Number of Times that the Divisor is contain'd in the Dividend, is called the *Quotient*. To which we may add a fourth Number, which sometimes happens when Division is made, that is always less than the Divisor; and therefore called the *Remainder*.

I WILL illustrate this by an easy Example: Suppose 'tis required to divide 10 by 3?

FIRST, I place the Numbers 3 and 10, as in the Margin, separating them from each other by the crooked Line *a a*, and also making another crooked Line on the Right Hand of the Divisor, as *nn*, to separate the Dividend from the Quotient.

	a	Dividend	*n*
Divisor	3)	10	(3 Quotient
	a)	9	*n*
		1 Remainder	

SECONDLY, I say, how often is 3, the Divisor, in 10, which is 3 times; then I set down 3 on the Right Hand of the Dividend, and multiply it by the Divisor, saying 3 times 3 is 9, which I set down under the 10.

THIRDLY, I subtract 9 from 10, and there rest 1, which I place under the 9, so is 1 the Remainder. And thus have you a View of the Divisor, Dividend, Quotient, and Remainder in their respective Places.

P. VERY *well, Sir: Pray proceed, for I believe I shall soon understand Division, since that there is no more to do, than first to place the Divisor and Dividend in their Places, and then finding how often the Divisor is contain'd in the Dividend, set down the same in the Quotient; after which multiplying the Quotient by the Divisor, and setting the Product under the Dividend, and subtracting it therefrom, gives the Remainder, which I see plainly must be less than the Divisor, otherwise the Divisor is not taken as often in the Dividend as it might have been.*

M. 'TIS

M. 'TIS true, you obſerve rightly, and your Obſervation on the Rule for Working, is very juſt; but as in farther Practice, you will find it more difficult than you are now apprehenſive of; I muſt therefore endeavour to introduce you in as plain and eaſy a Manner as I can. And in the firſt Place you muſt take Notice, that *Diviſion is either Single or Compound.*

P. PRAY *explain them ſeverally, and give me Examples therein.*

I WILL. Single Diviſion is when the Diviſor is but one ſingle Figure, and the Dividend but two at moſt, as in the foregoing Example. This kind of Diviſion is very eaſy, as you'll ſee by the following Examples.

DIVIDE 10 by 3, 11 by 4, 12 by 5, 13 by 6, 14 by 7, 15 by 8, 16 by 9, 17 by 2, 18 by 3, and 19 by 4.

Example I. 3)10(3 9 1 rem.	*Example* II. 4)11(2 8 3 rem.	*Example* III. 5)12(2 10 2 rem.	*Example* IV. 6)13(2 12 1 rem.	*Example* V. 7)14(2 14 0 rem.
Example VI. 8)15(1 8 7 rem.	*Example* VII. 9)16(1 9 7 rem.	*Example* VIII. 2)17(1 16 1 rem.	*Example* IX. 3)18(6 18 0 rem.	*Example* X. 4)19(4 16 3 rem.

IN theſe Examples you are to obſerve, That in Example I. 10 divided by 3, the Quotient is 3, and 1 remains. That in Example II. 11 divided by 4, the Quotient is 2, and 3 remains. That in Example III. 12 divided by 5, the Quotient is 2, and 2 remains. That in Example IV. 13 divided by 6, the Quotient is 2, and 1 remains. And ſo in like manner obſerve the Quotient and Remains of all the other Examples, which being ſo very plain, needs no further Account.

P. 'TIS *true, Sir, I ſee this kind of Diviſion very perfectly, and is what I believe I can perform by the Table of Multiplication; for ſuppoſe I ſeek my Diviſor at the Top of the Table, and run down the ſame Column until I find the Dividend, or the neareſt Number to it, then over-againſt it in the firſt Column ſtands the Quotient required. As for Example; To divide* 10 *by* 3. *Firſt I find* 3, *the Diviſor, at the Head of the Table, and run down it to find* 10; *but there being no ſuch Number in the third Column, therefore I take the neareſt Number to* 10, *which is* 9, *againſt which ſtands* 3 *for the Quotient; and as* 9 *is* 1 *leſs than* 10, *therefore* 1 *is the Remainder: And ſo in like manner any other Numbers.*

M. I MUST aſſure you I am highly pleaſed to ſee that you ſo well underſtand as you proceed. Here you have in a manner connected Multiplication and Diviſion together, which I could not have expected ſo early. I ſhall now proceed to Compound Diviſion.

P. PRAY *what is to be underſtood by the Words Compound Diviſion.*

M. COM-

M. COMPOUND DIVISION is when the Dividend confifts, or is compounded of more Figures than two, and the Divifor of one or more; and when a Queftion of Compound Divifion is propofed, it muft be performed by the following

RULE.

FIRST, Write down your Dividend, with crooked Lines at either Ends thereof, as before taught; that on the Left-hand to contain the Divifor, and that on the Right-hand for the Quotient.

SECONDLY, Diftinguifh with a Point, fo many Places of your Dividend towards the Left-hand, as are equal, or next exceeding your Divifor.

THIRDLY, Afk how often your Divifor is contain'd in the faid Number, or Figures fo pointed, and place the Number of Times in your Quotient on the Right-hand the Dividend.

FOURTHLY, Multiply the Divifor by the Figure laft placed in the Quotient, and fet the Product underneath the pointed Figures.

FIFTHLY, Draw a Line under the Product laft fet down, and fubtract that Product from the Figures of the Dividend pointed out, and to the Remainder bring down your next Figure of your Dividend, with which proceed as you did with your firft pointed Number, and fo on 'till you have pointed and brought down all the Figures of the Dividend.

Note, IF it fhould fo happen, that at any time, when you have pointed and brought down a Figure to a Remainder, you cannot find your Divifor one time therein; then, at every fuch time, you muft place, or add a Cypher to the other Figure or Figures in the Quotient, and point and bring down another Figure from the Dividend, and then proceed as before.

YOU may alfo here obferve, That as many Points as you have made in your Dividend, fo many Figures will be in the Quotient; and therefore from hence you fee the Neceffity of placing a Cypher in the Quotient at all fuch Times, when your Divifor cannot be found once in your Remainders with the next pointed Figure brought down as aforefaid.

THIS *Rule I will illuftrate by the following Examples.*

Example I. *By one Figure.*

DIVIDE 79243 by 6.

```
6)79243(13207
  6····
  —
  19
  18
  ——
   12
   12
   ———
    043
     42
    ——
     1 Remains
```

FIRST, Place your Dividend and Divifor, as in the Margin; then feeing that you can have your Divifor once in the firft Figure 7 of the Dividend, fay the 6's in 7 once, fet down 1 in the Quotient, and fay, once 6 is 6, which fet under the 7, and fubtract the 6 from 7, reft 1, which fet under the 6.

SECONDLY, Make a Point under the next Figure of the Dividend 9, and bring down the 9 to the 1 remaining, which will then be 19; then fay, how often the Divifor 6 is in 19? Anfwer 3; fet down 3 in the

Quotient,

Quotient, and multiply the Divifor by it, faying, 3 times 6 is 18, which fet down under 19, and fubtract it from 19, refts 1.

THIRDLY, Make a Point under the next Figure of the Dividend 2, and bring down the 2 to the Remainder 1, which will then be 12; then fay how often is the Divifor 6 in 12? Anfwer, Twice; then fet down 2 in the Quotient, and multiply the Divifor by it, faying, 2 times 6 is 12, which fet down under 12, and fubtract it from 12, reft 0.

FOURTHLY, Make a Point under the next Figure of the Dividend 4, and bring down the 4 to the Remainer 0; and fince that in 4 you cannot have the Divifor 6 once, therefore fet a Cypher in the Quotient, and point and bring down the next Figure of the Dividend 3, which will make the 4 43; then fay the 6's in 43? Anfwer, 7 times, write down 7 in the Quotient, and multiply the Divifor by it, faying 7 times 6 is 42, which fet under 43, and fubtract it from thence, and 1 remains. Thus will you have finifhed your Sum, whofe Quotient is 13207.

Example II. *By Two Figures.*

DIVIDE 9547243 by 47.

```
47)9547243(203132
   94·····
   ---
   147
   141
   ---
     62
     47
     ---
     154
     141
     ---
      133
       94
      ---
       39
```

FIRST, Your Divifor and Dividend being placed as before taught, begin the Divifion, and fay, how often is 47 in 95, the firft two Figures of the Dividend, which will be found 2 times, fet down 2 in the Quotient, and fay 2 times 47 is 94, which fet under 95, and fubtract it from thence, reft 1, which fet under the 4 of the 94.

SECONDLY, Make a Point under the next Figure of the Dividend 4, and bring down the 4 to the 1 remaining, which will make it 14; and becaufe that 47 cannot be had in 14, therefore place a Cypher in the Quotient on the Right-hand of the 2, and then point the next Figure 7, and bring it down to the 14, which then will become 147; then fay the 47's in 147? Anfwer 3 times, which write down in the Quotient, and multiply the Divifor by it, faying 3 times 47 is 141, which fet under 147, and fubtract it from thence, refts 6.

THIRDLY, Point and bring down the 2 to the 6 remaining, making it 62; then fay the 47's in 62 one time, fet down 1 in the Quotient, and once 47 under 62, and fubtract it from thence, refts 15.

FOURTHLY, To the 15 remaining, bring down the 4, making the 15, 154; then fay, the 47's in 154? Anfwer, 3 times, fet down 3 in the Quotient, and fubtract 141 from 154, refts 13.

FIFTHLY, To the 13 remaining bring down the 3, making the 13, 133; then fay the 47's in 133? Anfwer, 2 times, fet down 2 in the Quotient, and fay twice 47 is 94, which fet under 133, and fubtracting it, there refts 39, which is the Remainer, and the Quotient is 203132.

P. SIR, *I underſtand your Method very rightly, and I ſee that every Part of it is eaſy, excepting that of finding how often the Diviſor is contain'd in the Numbers made by the ſeveral Figures of the Dividend brought down, which I muſt own is ſomething difficult to me, and I apprehend will be yet more difficult, when that the Diviſion conſiſts of* 3, 4, 5, *or more Figures.*

M. THAT Piece of Difficulty I will remove, and make it eaſy and delightful to you, without charging your Memory in the leaſt.

P. PRAY *proceed, for herein I ſhall have abundance of Pleaſure.*

M. THAT you may readily find how often your Diviſor will go in any Number propoſed, you muſt firſt (after your Diviſor and Dividend are truly placed) *make a Table of Diviſors*, which is no more than your Diviſor multiplied into the 9 Figures, as following; Suppoſe I am to divide 792423, by 53, then I firſt place the Diviſor and Dividend in their Places, and make a Table of Diviſors, as in the Margin. This Table, and all others of the like kind, are made moſt eaſy, as follows:

TABLE *of Diviſors.*

A	53	1	Times
B	106	2	
C	159	3	
D	212	4	
E	265	5	
F	318	6	
G	371	7	
H	424	8	
I	477	9	

53)792423(14951
53
262
212
504
477
272
265
73
53
20

FIRST, Write down your Diviſor 53, as againſt A, and on the Right-hand Side of it, write down the Number 1, ſignifying it once, or one Time. This done, double it, or multiply it by 2, ſaying, twice 3 is 6, and twice 5 is 10, making 106, againſt which ſet Number 2, ſignifying 2 times.

SECONDLY, Add the 2 Numbers together, and they make 159, againſt which place Number 3, ſignifying 3 times; then to this laſt Number 159, add the upper one 53, and againſt the Total ſet Number 4, ſignifying 4 times; to this laſt Number add the firſt, as before, until you have ſo added the Diviſor 9 times; which being done, your Diviſion will become very eaſy, as following:

FIRST, Say the 53's in 79 is once, I write 1 in the Quotient, and 53 under 79, and ſubtracting it from thence, reſts 26.

SECONDLY, To 26 I bring down the Figure 2, making the 26, 262; then I ſay how often 53 in 262, and looking in the Table of Diviſors for the neareſt leaſt Number to 252, I find 212, againſt which ſtands 4 times, then I ſet 4 in the Quotient, and 212 under 262, and Subtraction being made, reſts 50.

THIRDLY, Bring down the 4 to the 50, making it 504; then ſay how often 53 in 504, and looking in the Table of Diviſors for the neareſt leaſt Number to 504, I find 477, againſt which ſtands 9 times; then I ſet 9 in the Quotient, and 477 under 504, and Subtraction being made, reſts 27.

FOURTHLY

FOURTHLY, Bring down the next Figure 2 of the Dividend, to the 27, making it 272; then ſay how often 53 in 272, looking in the Table for the next leaſt Number thereto, I find 265, againſt which ſtands 5 times; then I ſet 5 in the Quotient, and 265 under 272, and Subtraction being made, reſts 7.

FIFTHLY, To the 7 remaining, bring down the 3 of the Dividend, making the 7, 73; then ſaying the 53's in 73, is 1 time, ſet down 1 in the Quotient, and 53 under 73, and Subtraction being made, reſts 20 for a Remainer, and the Quotient will be 14951.

BY this way of finding your Diviſor, you will attain to a good Knowledge of Diviſion, and be enabled to work eaſily without ſuch a Table.

I WILL give you ſome other Examples for Practice.

Example I.

Divide 998877 *by* 543.

Table.		
543	1	543)998877(1839
1086	2	543···
1629	3	4558
2172	4	4344
2715	5	2147
3258	6	1629
3801	7	5187
4344	8	4887
4887	9	300 rem.

Example II.

Divide 5432729 *by* 4532

Table.		
4532	1	4532)5432729(1198
9064	2	4532···
13596	3	9007
18128	4	4532
22660	5	44752
27192	6	40788
31724	7	39649
36256	8	36256
40788	9	3393 rem.

P. SIR, *I thank you; I ſee that by making Tables of Diviſors, Diviſion is very eaſy; but pray tell me how I muſt know to find the Value of the Remainer, which in the laſt Example was* 3393.

M. THE Remainer, when any, after Diviſion is ended, is the Numerator of a Fraction, and the Diviſor is a Denominator thereto, and are generally annex'd to the Quotient; as in the firſt Example the Quotient is 1839, and 300 remaining, which muſt be thus written, 1839 $\frac{300}{543}$. And in the laſt Example, to the Quotient 1198, ſhould be annex'd the Remains 3393, as thus, 1198 $\frac{3393}{4532}$: In both of which Examples, the Remainer is ſet over the Diviſor, ſeparated by a Line, as you ſee here, and the Diviſor is always to be placed the undermoſt, as being the greateſt of the two.

P. PRAY *what is to be underſtood by the Word Fraction? and why is the Remainer called the Numerator, and the Diviſor the Denominator of a Fraction?*

M. A FRACTION is a Broken Number, and always leſs than Unity, as $\frac{3}{4}$, or $\frac{1}{2}$, or $\frac{1}{4}$, repreſents Three quarters, One half, or One quarter of any thing, or Unity: And if the Diviſor to a Sum of Diviſion be conſidered as an Integer or Unity, then the Remains, after Diviſion is made, being leſs, is therefore called a Fraction, being but a Part thereof: And as the Diviſor

expreſſes

expreſſes the Number of Parts into which 'tis divided, it is therefore called the Denominator; and ſo in like manner, as the Remainer expreſſes, or numerates how many of thoſe Parts are remaining, it's therefore called the Numerator to the Fraction; and Fractions of this kind, are called Vulgar Fractions. More of which I ſhall inſtruct you hereafter in its proper Place.

HAVING thus ſhewn you how to expreſs and write down your Remainer, and to annex it to your Quotient as a Fraction, I ſhall in the next Place ſhew you how to find the Value thereof.

SUPPOSE that the laſt Example was 5432729 l. to be equally divided between 4532 Men, where you ſee that the Quotient is 1198 l. to each Man, and 3393 remaining, whoſe Value is found by the following

RULE.

FIRST, Multiply the Remainer by the Number of Parts into which an Integer of the Dividend is divided; as here an Integer of the Dividend, which is one Pound, is divided into 20 s. therefore multiply the Remainer 3393 by 20, and dividing the Product by the ſame Diviſor 4532, the Quotient is Shillings.

SECONDLY, Multiply the Remainer of this laſt Diviſion, by the Number of Parts into which a Shilling is divided, *viz.* 12 Pence, and dividing the Product by the aforeſaid Diviſor, the Quotient will be Pence.

LASTLY, Multiply the Remains, if any, by 4, the Farthings in a Penny, and dividing the Product by the Diviſor aforeſaid, the Quotient will be Farthings.

Example.

The Remains of the laſt Sum was 3393
Multiply by - - - - - - - 20 the Shillngs in a Pound.
Divide by - - - - 4532)67860(14 Shillings.
4532·
22540
18128
4412 remains.
Multiply by - - - - - - - 12 the Pence in a Shilling.
Divide by - - - - 4532)52944(11 Pence.
4532·
7624
4532
3092 remains.
Multiply by - - - - - - - 4
Divide by - - - - 4532)12368(2 Farthings.
9064
3304

SO the true Quotient, or each Man's Part, is 1198 l. 14 s. 11 d. $\frac{1}{2}$: And here note, That the ſame Table of Diviſors ſerves for dividing the ſeveral Products hereof, as you made for the Diviſion of the given Number.

P. SIR; *I ſee your Method very plainly; but how ſhall I know when my Work is right or wrong, for I don't remember that you have yet taught me how to prove Diviſion.*

M. 'TIS true, I have not yet taught you how to prove your Work, which I will now do, as follows.

RULE.

MULTIPLY *your Quotient by your Diviſor, and the Product will be equal to the Dividend.*

Example.

Divide 55432, *by* 721.

Table of Diviſors.

721	1
1442	2
2163	3
2884	4
3605	5
4326	6
5047	7
5768	8
6489	9

Multiply	721	the Diviſor
By	76	the Quotient
	4326	
	5047	
C	54796	Product.
To which add	636	the Remains.
E	55432	Total, equal to the Dividend, which is the Proof required.

721)55432(76
5047
4962
4326
636 re.

TO prove this Diviſion, you ſee here, that 721, the Diviſor, is multiplied by 76, the Quotient, and the Product is 54796, as at C. To this add 636, the Remainer, and the Total will be 55432, as at E, equal to the Dividend given.

P. SIR, *Your Manner of proving Diviſion is very demonſtrable; for ſince that the Quotient is no more than the Number of Times which the Diviſor is contain'd in the Dividend; therefore if the Diviſor be multiplied by the Quotient, it muſt produce a Number equal to the Dividend at all Times when the Diviſion is ended and nothing remaining: But when there is a Remainer, then that being added to their Product, makes up the Total equal to the Dividend; for, as you have taught me to know, the Whole is equal to all its Parts taken together in one Sum.*

M. I AM pleas'd to obſerve that you ſo juſtly ſee into the Reaſons of your Operations, and therefore I ſhall, in the next Place, proceed further to ſhew you ſome Rules for contracting your Works in many Caſes, which I call

CONTRACTIONS *in* DIVISION.

FIRST, When your Diviſor is an Unit, with any Cyphers annex'd to the Right-hand, cut off from your Dividend the ſame Number of Figures in their reſpective Places, the Remainer is the Quotient, and the Figures cut off, are the Numerators of a Decimal Fraction: So if I was to divide 1729 by 10, I cut off the laſt Figure 9, as in the Margin, becauſe that there is one Cypher in the Diviſor;

10) 172|9(

then

then will the other Figures 172, be the Quotient, and the 9 ſtruck off is a Remainer $\frac{9}{10}$.

AGAIN, To divide 27325 by 100, I ſtrike off 2 Figures towards the Right-hand, as in the Margin, becauſe in the Diviſor 100, there are Cyphers; then will the remaining Figures 273 be the Quotient, and 25 remaining, which is $\frac{25}{100}$. In like manner 9762543, divided by 1000, the Quotient is 9762 $\frac{543}{1000}$.

```
1|00)273|25(
```

SECONDLY, When your Diviſor and Dividend conſiſt of Cyphers to the Right-hand, cut or point off from both, an equal Number, and then proceed with the remaining Figures, as by the Rules before given. As for

Example.

Divide 47325000, *by* 12000.

```
12|000)47325|000(3943
       36...
       ---
       113
       108
       ---
        52
        48
       ---
        45
        36
       ---
         9
```

HERE I cut off three Cyphers in the Diviſor, and as many in the Dividend, and then 12 is become the Diviſor, and 47325 the Dividend.

THIRDLY, When your Diviſor has Cyphers annex'd, they may be omitted, and ſo many of the laſt Figures in your Dividend cut off, and then proceed as before. As for

Example.

Divide 6327495 *by* 13000.

```
13|000)6327|495(486
        52...
        ---
        112
        104
        ---
         87
         78
        ---
          9
```

BUT after the Diviſion is made, the Cyphers are to be reſtored to the Diviſor, and the Figures cut from the Dividend added to the Remainer for a Numerator.

SO here the Figures cut off, 495, muſt be added to the Remainer 9 for a Numerator, which will be 504, and the Denominator is the Diviſor 13000; wherefore the Fraction is $\frac{504}{13000}$, and the Quotient 486 $\frac{504}{13000}$.

THESE are rhe moſt material Contractions in Diviſion, which being well underſtood, with the preceding Rules, you will eaſily divide any Number of Integers required.

I SHALL conclude this Lecture with giving you the following Queſtions for Practice.

Q. I.

Q. I. *In 729543 Inches in Length, how many Feet?*

RULE. As 12 Inches make 1 Foot, therefore divide the given Number 12.

ANSWER. 60795 Feet 3 Inches.

```
12)729543(60795 Feet.
   72....
   ---
   095
    84
   ---
    114
    108
    ---
      63
      60
      --
       3 Inches.
```

Q. II. *In 954327 Feet, how many Yards?*

RULE. Because that 3 Feet make 1 Yard, therefore divide the given Number by 3.

3) 954327 (318109 Yards.

NOTE, That to divide by 3, you need only write down the Quotient as you run through the Dividend; saying, the 3's in 9, 3 times, set down 3 in the Quotient; then the 3's in 5 once, set down 1 in the Quotient, and carry 2 to the next Figure 4; and say, the 3's in 24 is 8 times, set down 8 in the Quotient; then the 3's in 3 is once, set down the 1 in the Quotient; then the 3's in 2 not once, therefore place a Cypher in the Quotient. Lastly, the 3's in 27 is 9 times, set down 9 in the Quotient, and then the Quotient will be 318109 Yards, the Answer required.

Q. III. *In 7299367 Yards, how many Fathoms?*

RULE. Because that 2 Yards make 1 Fathom, therefore divide by 2.

2) 7299367 (3649683 $\frac{1}{2}$

NOTE, That to divide by 2, you need only take half the Dividend, and place that in the Quotient, saying, half 7 is 3, set 3 in the Quotient; then half 12 is 6, set 6 in the Quotient; then half 9 is 4, set 4 in the Quotient; then half 19 is 9, set 9 in the Quotient; then half 13 is 6, set 6 in the Quotient; then half 16 is 8, set 8 in the Quotient; then half 7 is 3 $\frac{1}{2}$: So the Quotient is 3649683 $\frac{1}{2}$.

Q. IV. *In 7253472 Feet, how many Rods or Poles?*

RULE. Because that 16 Feet and $\frac{1}{2}$ make 1 Pole or Rod, therefore divide the given Number by 16 $\frac{1}{2}$.

NOTE, When you have a Fraction at the End of your Divisor, as in this Example, you must multiply both the Integers of the Divisor and Dividend, by the Denominator of the Fraction, and then proceed as before. So in this Example I multiply 16, the Divisor, by 2, the Denominator of the Frac-

```
             16½) 7253472(
Multiply by  - - -       2
             ------------
             33)14506944(439604 Rods.
                132.....
                ---
                 130
                  99
                 ---
                 316
                 297
                 ---
                  199
                  198
                  ---
                    144
                    132
                    ---
                     12 remains, equal
                              to 6 Feet.
```

tion,

tion, which makes 32, and the Numerator 1 of the Fraction, added to it, makes 33, which is my new Divisor; then multiplying the Dividend 7253472 by 2, the Product is 14506944, which being divided by 33, the Quotient is 439604, and 12 remaining, which 12 must be divided by 2, and is but 6 Feet. And so in like manner all others of the same Nature.

Q. V. *In* 7294327 *Yards, how many Rods or Poles?*

RULE. Because that 5 Yards and $\frac{1}{2}$ make 1 Rod or Pole, therefore divide the given Number by $5\frac{1}{2}$, as directed in the last Question.

$5\frac{1}{2}$) 7294327(
Multiply by - - - 2

11)14588654(1326241
11 · · · · · ·
35
33
28
22
68
66
26
22
45
44
14
11
3 remains, equal to $1\frac{1}{2}$

Q. VI. *In* 5729257 *Links, how many Chains?*

RULE. Because that in one Chain there is 100 Links, therefore divide the given Number by 100.

1|00)57292|57(

HERE you need only cut off the two last Figures in the Dividend, the 5 other remaining Figures is the Quotient, or Answer, and the Figures cut off, are Remainers.

THE Reason of this is, because that in the Divisor there are 2 Cyphers, and that the 1 doth not divide any more than it multiplies, wherefore the aforesaid Part of the Dividend is equal to the Quotient.

Q. VII. *In* 7254379 *Pounds Avoirdupoize, how many Hundred weight at* 112 lb. *to the Hundred, which is called the Great Hundred?*

RULE. Because that in one Hundred there is 112 Pounds, therefore divide the given Number by 112.

NOTE, For your ready performing the Operation, first make a Table of Divisors, as you see here prefix'd.

112	1
224	2
336	3
448	4
560	5
672	6
784	7
896	8
1008	9

112)7254379(64771 Hundreds.
672 · · · ·
534
448
863
784
797
784
139
112
27 Pounds remains.

Q. VIII

Q. VIII. *In 97254978 Hundreds Avoirdupoize, how many Tons?*

RULE. Becauſe that 20 Hundred weight make one Ton weight, therefore divide the given Number by 20.

```
20)97254978(4862748 Tons.
   80
   ---
   172
   160
   ---
    125
    120
    ---
     54
     40
     ---
     149
     140
     ---
      97
      80
      ---
      178
      160
      ---
       18 Hundred remains.
```

Q. IX. *In 67432543 Hundreds weight of Lead, how many Fodder?*

RULE. Becauſe that 19 Hundred and ½ make one Fodder of Lead, therefore divide the given Number by 19 ½.

NOTE, Here you muſt firſt multiply your Dividend by 2 the Denominator of the Fraction ½; alſo the Diviſor the ſame, adding to it the Numerator 1; and then your Diviſor and Dividend conſiſts of ſo many ½ Hundreds, which being divided by the foregoing Rules, the Quotient will be Fodders, and the Remains after Diviſion is ended, are ½ Hundreds, as expreſs'd in the Margin.

```
19 ½)67432543
             2
   ------------
39)134865086(3458079 Fodders.
   117
   ---
    178
    156
    ---
     226
     195
     ---
      315
      312
      ---
       308
       273
       ---
        356
        351
        ---
          5 remains, equal to
            2 Hundred and ½.
```

Q. X. *In 7954379 ſolid Feet of Timber, how many Loads?*

RULE. Becauſe that 50 Feet make 1 Load, therefore divide the given Number by 50.

```
50)7954379(159087 Loads.
   59
   ---
   295
   250
   ---
    454
    450
    ---
     437
     400
     ---
      379
      350
      ---
       29 Feet remains.
```

Q. XI. *In 9543217 solid Feet of Timber, how many Tons?*

RULE. Becaufe that 40 folid Feet make 1 Tun of Timber, therefore divide the given Number by 40.

```
40(9543217(238580 Tons.
  80.....
  ---
  154
  120
  ---
   343
   320
   ---
    232
    200
    ---
     321
     320
     ---
      17 Feet remains.
```

Q. XII. *In 93274359 Bricks, how many Loads?*

RULE. Becaufe that 500 Bricks make one Load, therefore divide the given Number by 500.

```
500(93274359(186548 Loads.
    500.....
    ----
    4327
    4000
    ----
     3274
     3000
     ----
      2743
      2500
      ----
       2435
       2000
       ----
        4359
        4000
        ----
         359 Bricks remains.
```

Q. XIII. *In 793274 Baggs of Lime, how many Hundreds?*

RULE. Becaufe that 25 Baggs make one Hundred of Lime, therefore divide by 25.

```
25)793274(31730 Hundreds.
   75....
   --
    43
    25
    --
    182
    175
    ---
      77
      75
      --
      24 Bags remains.
```

Q. XIV.

Q. XIV. *In* 743275 *Bushels of Sand, how many Loads?*

RULE. Because that 18 Bushels of Sand make one Load, therefore divide the given Number by 18.

```
18)743275(41293 Loads.
   72....
   --
    23
    18
    --
     52
     36
     ---
     167
     162
     ---
       55
       54
       --
        1 Bushels remains.
```

Q. XV. *In* 987654321 *Square Inches, how many Square Feet?*

RULE. Because that 144 Square Inches make one Square Foot, therefore divide the given Number by 144.

Divisors	
144	1
288	2
432	3
576	4
720	5
864	6
1008	7
1152	8
1296	9

```
144)987654321(6858710 Square Feet.
    864......
    ----
    1236
    1152
    ----
      845
      720
      ----
      1254
      1152
      ----
       1023
       1008
       ----
          152
          144
          ---
           81 Square Inches remains.
```

Q. XVI. *In* 5432176 *Square Feet, how many Square Yards?*

RULE. Because that 9 Square Feet make one Square Yard, therefore divide the given Number by 9.

```
9)5432176(603575 Square Yards.
  54.....
  --
   32
   27
   --
    51
    45
    --
     67
     63
     --
      46
      45
      --
       1 Square Foot remains.
```

Q. XVII.

Q. XVII. *In* 97254327 *Square Feet of Brick-work, how many Square Rods?*

RULE. Because that 272 square Feet and quarter make one square Rod, therefore divide the given Number by $272\frac{1}{4}$.

NOTE, That as the Divisor consists of a Fraction, whose Denominator is 4, you must therefore multiply the Dividend and Divisor by 4, to which last you add the Numerator 1, and then they will be transposed into Quarters. This done, divide the one by the other, and the Quotient will be the Answer required.

```
2724) 97254327
             4          Poles.   Feet.
1089)389017308(357224   118        Divisors
     3267·····                     1089 1
     ----                          2178 2
      6231                         3267 3
      5445                         4356 4
      ----                         5445 5
       7867                        6534 6
       7623                        7623 7
       ----                        8712 8
        2443                       9791 9
        2178
        ----
         2650
         2178
         ----
          4728
          4356
          ----
           472
```

472 remains, which must be divided by 4, they being but Quarters of Feet, caused by the multiplying of the Dividend and Divisor by 4, and are equal to 118 Square Feet.

Q. XVIII. *In* 8832574 *Square Rods of Land, how many Acres.*

RULE. Because that 160 square Rod make 1 Acre, therefore divide the given Number by 160.

```
              160 ) 8832574 ( 55203 Acres.
                    800····
 160 1              ---
 320 2               832
 480 3               800
 640 4               ---
 800 5                325
 960 6                320
1120 7                ---
1280 8                 574
1440 9                 480
                       ---
                        94 Rods rem.
```

Q. XIX. *If a Piece of Land is* 15 *Rod in Breadth, how many Rod in Length must I go to measure out an exact Acre.*

RULE. Divide 160, the Number of Rods in an Acre, by the given Breadth 15, and the Quotient will be the Length that must be taken to make an exact Acre. For as many 15 Rods as are to be had in 160 Rods, so many times 1 must be taken in Length.

```
15)160(10 Rods 2/3
   15
   --
    10
   --
```

Answer. 10 Rods $\frac{10}{15}$ equal to $\frac{2}{3}$.

Q. XX.

Q. XX. *In 9732542 square Feet of Flooring, Tyling, or Partitioning, how many Squares of Work?*

RULE. Becaufe that 100 fquare Feet make one Square of Work, therefore divide the given Number by 100, and the Anfwer will be 97325 Squares, and 42 Feet.

```
1|00)97325|42(
```

Q.XXI. *In 973254791 folid Inches, how many folid Feet?*

RULE. Becaufe that 1728 folid Inches make 1 folid Foot, therefore divide the given Number by 1728.

```
 1728 1
 3456 2
 5184 3
 6912 4
 8640 5
10368 6
12096 7
13824 8
15552 9
```

```
1728)973254791(563226 Solid Feet.
     8640·····
     -----
     10925
     10368
     -----
       5574
       5184
       ----
        3907
        3456
        ----
         4519
         3456
         -----
         10631
         10368
         -----
           263 Solid Inches remains.
```

Q. XXII. *In 7963427 folid Feet, how many folid Yards?*

RULE. Becaufe 27 folid Feet make one folid Yard, therefore divide the given Number by 27.

```
27)7963427(294941 Solid Yards.
   54·····
   --
   256
   243
   ---
    133
    108
    ---
     254
     243
     ---
      112
      108
      ---
        47
        27
        --
        20 Solid Feet remains.
```

Q. XXIII. *In 95327549 Yards, how many Miles?*

RULE. In one Mile there is 1760 Yards, therefore divide the given Number by 1760.

```
 1760 1
 3520 2
 5280 3
 7040 4
 8800 5
10560 6
12320 7
14080 8
15840 9
```

```
1760)95327549(54163 Miles.
     8800····
     ----
      7327
      7040
      ----
       2875
       1760
       -----
       11154
       10560
       -----
         5949
         5280
         ----
          669 Yards remains.
```

Q. XXIV. *In 7954327 Rods of Land, how many Roods?*

RULE. Becauſe 40 Rods make one Rood, therefore divide the given Number by 40.

```
40)7954327(198858 Rood
   40·····
   395
   360
    354
    320
     343
     320
      232
      200
       327
       320
         7 Rods remains.
```

Q. XXV. *In 793254 Roods of Land, how many Acres?*

RULE. In one Acre of Land there is 4 Roods, therefore divide the given Number by 4.

```
4)793254(198313 Acres.
  4·····
  39
  36
   33
   32
    12
    12
      5
      4
      14
      12
       2 Roods remains.
```

Q. XXVI. *In 79735421 Feet of one Inch Plank, how many Loads?*

RULE. Becauſe 600 Feet of one Inch Plank make one Load, therefore divide the given Number by 600.

```
600)79735421(132892 Loads.
    600·····
    1973
    1800
     1735
     1200
      5354
      4800
       5542
       5400
        1421
        1200
         221 Feet remains.
```

Q. XXVII.

Q. XXVII. *In 55327245 Feet of Inch and half thick Plank, how many Loads?*

RULE. Becauſe that 400 ſquare Feet of Inch and half Plank make 1 Load, therefore divide the given Number by 400.

```
400)55327245(138318 Loads.
    400·····
    ----
    1532
    1200
    ----
     3327
     3200
     ----
      1272
      1200
      ----
        724
        400
        ----
        3245
        3200
        ----
          45 Feet remains.
```

Q. XXVIII. *In 77243257 Feet of Two Inch thick Plank, how many Loads?*

RULE. Becauſe that 300 Feet make one Load of Plank two Inch thick, therefore divide the given Number by 300.

```
300)77243257(257477 Loads.
    600·····
    ----
    1724
    1500
    ----
     2243
     2100
     ----
      1432
      1200
      ----
       2325
       2100
       ----
        2257
        2100
        ----
         157 Feet remains.
```

Q. XXIX. *In 5439762 Feet of three Inch Plank, how many Loads?*

RULE. Becauſe that 200 Feet of three Inch Plank make one Load, therefore divide the given Number by 200.

```
200)5439762(27198 Loads.
    400····
    ----
    1439
    1400
    ----
      397
      200
      ----
      1976
      1800
      ----
       1762
       1600
       ----
        162 Feet. remains.
```

Q. XXX.

Q. XXX. *In 9977882 Feet of four Inch thick Plank, how many Loads?*

RULE. Because that 150 Feet of 4 Inch thick Plank make one Load, therefore divide the given Number by 150.

```
150)9977882(66518 Loads.
    900····
    ───
    977
    900
    ───
     778
     750
     ───
      288
      150
      ───
      1382
      1200
      ────
       182 Feet remains.
```

Q. XXXI. *In 54321797 Minutes of Time, how many Hours?*

RULE. Because that 60 Minutes make one Hour, therefore divide the given Number by 60.

```
60)54321797(905363 Hours.
   540·····
   ───
    321
    300
    ───
     217
     180
     ───
      379
      360
      ───
       197
       180
       ───
        17 Minutes remains
```

Q. XXXII. *In 77254321 Hours, how many Days?*

RULE. Because that 24 Hours make a natural Day, therefore divide the given Number by 24.

```
24)77254321(3218930 Days.
   72······
   ──
    52
    48
    ──
     45
     24
     ───
     214
     192
     ───
      225
      216
      ───
        72
        72
        ──
         1 Hour remains.
```

Q. XXXIII. *In 5321765 Days, how many Weeks?*

RULE. Because that 7 Days make one Week, therefore divide the given Number by 7.

```
7)5321765(760252 Weeks
  ······
        1 Day remaining.
```

Q. XXXIV.

Q. XXXIV. *In 7325479 Weeks, how many Years?*

RULE. Becauſe that 52 Weeks make 1 Year, therefore divide the given Number by 52.

```
52)7325479(140874 Years.
   52
   ---
   212
   208
   ---
     454
     416
     ---
      387
      364
      ---
       239
       208
       ---
        31 Weeks remain.
```

Q. XXXV. *How many Paving Bricks, each 9 Inches long, and 4 Inches ½ wide, will pave a Cellar that contains 120 ſquare Feet?*

RULE. Firſt find the Quantity of ſquare Inches contain'd in one Brick; which is done by multiplying the Length, 9 Inches, by the Breadth, 4 Inches ½, and the Product is 40 Inches and ½. This you are to reſerve for your Diviſor.

```
 9
 4 ½
----
36
 4 ½
----
40 ½ the ſquare Inches of 1
     Brick.
```

Secondly, Find the Quantity of ſquare Inches in 120 ſquare Feet; which is done by multiplying 120 by 144, and the Product is 17280; which is your Dividend.

```
  144
  120
 -----
 2880
144
 -----
17280 the ſquare Inches in
      120 ſquare Feet.
```

Thirdly, Divide 17280 by 40 ½, and the Quotient will be 426, the Number of the Bricks required, and 27 ſquare Inches remaining.

```
40 ½)17280(
         2
    -------
 81)34560(426 Bricks.
    324
    ---
     216
     162
     ---
      540
      486
      ---
       54 which is equal to 27
          Inches.
```

Q. XXXVI. *How many Paving Tiles, each* 10 *Inches ſquare, will pave a Kitchen that contains* 10000 *ſquare Feet?*

RULE. Firſt find the Quantity of ſquare Inches contained in one Tile; which is done by multiplying 10 Inches, the Length, by 10 Inches, the Breadth, and the Product is 100 Inches. This you are to reſerve for a Diviſor.

SECONDLY, Find the Quantity of ſquare Inches contained in 10000 ſquare Feet; which is done as before in the laſt Queſtion, by multiplying 10000 by 144, and the Product will be 1440000, which is your Dividend.

THIRDLY, Divide 1440000 by 100, and the Quotient is 14400, which is the Number of Tyles required.

100)14400|00(14400 Tyles.

$$\begin{array}{rl} 10 & \\ 10 & \\ \hline 100 & \text{The square Inches in a Tyle.} \end{array}$$

$$\begin{array}{rl} 10000 & \\ 144 & \\ \hline 1440000 & \text{The square Inches in the 10000 Feet.} \end{array}$$

THUS have I exemplified the principal Rules of Vulgar Arithmetick; which being well underſtood, you will be enabled to engage with the Solutions of any Queſtion compriſed by them.

IT is uſual for all Maſters of Arithmetick to impoſe on the young Student a ſixth Rule, which they call Reduction; when in Fact it is no more than the Application of Multiplication and Diviſion, according to the Nature of the Propoſition to be ſolved.

THAT is, if we are to change Money, Weight, Meaſures, &c. out of one Denomination into another, we have only this to conſider; that is to ſay, if the propoſed Quantity be to be changed into another of a leſs Denomination, ſuch as Shillings into Pence, or Feet into Inches, then we muſt conſider how many Pence are contain'd in a Shilling, or Inches in a Foot, and multiply the Number propoſed by the ſame: That is, if I am to change 10 Shillings into Pence, then I muſt multiply 10 by 12, the Number of Pence contained in one Shilling, and the Product is the Anſwer: And if I am to change Yards into Feet, then I multiply the Yards by 3, the Number of Feet in a Yard; and ſo in like manner all other Quantities, as has been already very largely handled in Multiplication.

ON the contrary, if the propoſed Quantity be to be changed into another of a greater Denomination, ſuch as Pence into Shillings, Feet into Yards, &c. then we muſt conſider how many of the Number propoſed will make one of the Denomination intended, and then we muſt divide the Number propoſed by the ſame: That is, if I am to change Pence into Shillings, I muſt divide by 12, the Number of Pence in a Shilling: But if I am to change Pence into Pounds, then I muſt divide by 240, the Number of Pence in a Pound; and ſo in like manner any other Quantity, as has been already very largely exemplified in this Lecture of Diviſion.

I SHALL in the next Place ſhew you the Application of the Rules hitherto taught, to Practice in the Rule of Proportion, vulgarly called the GOLDEN RULE, or *Rule of Three.*

LECTURE

LECTURE VI.

Of the Rule of Proportion, or Golden Rule.

P. *PRAY why is this Rule called the Golden Rule?*

M. FOR the excellent Uſe thereof; which will be demonſtrated in this Lecture.

P. *AND is it therefore alſo called the Rule of Three?*

M. NO: It is called the Rule of Three, becauſe three is always three Numbers given to find a fourth, which muſt bear ſuch Proportion to the third, as the ſecond doth to the firſt. That is, if you divide the ſecond by the firſt, and the fourth by the third, and the two Quotients are equal, then thoſe four Numbers are ſaid to be proportional. As for Example: Let the Numbers 8 : 16; 32 : 64 be given.

Firſt, Divide 16 by 8, and the Quotient is 2. 8)16(2

Secondly, Divide 64 by 32, and the Quotient is 2 alſo.

NOW, I ſay, theſe Numbers are Proportionals. For as 8 is to 16, ſo is 32 to 64. And when four Numbers are thus proportional to the Product of the Means (that is to ſay, the ſecond and the third) is equal to the Product of the Extreams, which are the firſt and laſt: For 32 multiply'd by 16 (which, as I ſaid before, are the two Means) produce 512; and ſo in like manner 64 multiply'd by 8 (which are the two Extreams) produce 512 likewiſe. Therefore, if the Product of the two Means (that is to ſay, 512) be divided by the firſt Number 8, the Quotient will be equal to the fourth or laſt Number 64.

IT is from this that the Knowledge of a fourth Number ariſeth, which ſhall have ſuch Proportion to any one Number given, as the two Numbers given have to one another.

THIS RULE is performed either ſimple, by one Operation; or compound, by two Operations; and thoſe both direct and indirect. The *Golden Rule Direct,* is, if the ſecond Number be greater than the firſt, the fourth Number ſhall likewiſe be greater than the third; and ſo in like manner, if the ſecond Number be leſs than the firſt, the fourth Number ſhall likewiſe be leſſer. Therefore obſerve, that when in any Queſtion, more require more, or leſs require leſs, it is to be ſolved by the *Golden Rule Direct:* As if 10 Foot of Oak ſhould coſt 20 *s.* then 15 Foot muſt needs coſt more than 20 *s.* that is, it will coſt 30 *s.* which is, more Things require more Money, *&c.*

THE next Thing which you are to obſerve, is the Manner of placing the Terms or Numbers in their true Poſitions, which perform as following: After the

the firſt Team, place two Points; after the ſecond Term, four Points; and after the third Term, two Points.: As thus, 2 : 6 :: 4 : 12, which muſt be thus read, As 2 is to 6, ſo is 4 to 12. And here note, That the firſt and third Terms are always of the ſame Denomination or Name; as alſo are the ſecond and fourth; that is, If 6 Men perform a Piece of Work in 10 Days, then 12 Men could have done the ſame in 5 Days; which is thus ſtated:

Men.		*Days.*		*Men.*		*Days.*
6	:	10	::	12	:	5

wherein you ſee, that the firſt and third Terms do both denominate Men, and the ſecond and fourth denominate Days.

THE greateſt Difficulty in this Rule, is the Stating of your Queſtions truly; and that you may be ſure thereof, obſerve as followings:

1. THAT whereas there are always three Numbers given to find out a Fourth, you muſt diſtinguiſh thoſe Numbers, the one from the other, as following: That is, the firſt two, I would diſtinguiſh and call by the Name of Stated Numbers; and the third Number I would call the Demanding Number.

P. *Pray why do you thus diſtinguiſh them?*

M. FOR the following Reaſons. Firſt, As the Proportion of the Fourth to the Third is ever to be as the Second is to the Firſt; therefore in the two firſt Terms, or Numbers, the Proportion of the fourth Term is ſtated; and for that Reaſon, I call thoſe Terms, the Stated Numbers. Secondly, as the the third Number demands the Fourth, in Proportion to itſelf, as the Second is to the Firſt, therefore I call it the Demanding Number; and as it is the laſt of the three in the Demand, muſt therefore be always placed in the third Place.

Now, the only Difficulty remaining, is to know which of the two Stated Terms muſt be in the firſt Place; which you may readily deteremine as follows.

CONSIDER of what Denomination your Demanding Number is, and make that of your Stated Numbers, which is of the ſame Denomination, the firſt Term; and ſo will you have placed them in their true Poſitions, ready for the Solution required.

To ſolve all Queſtions in the Golden Rule Direct;

This is the RULE.

MULTIPLY the ſecond and third Terms together, and divide the Product by the firſt Term; the Quotient is the fourth Term, or Number required, which is of the ſame Denomination with the ſecond Number. Therefore,

IF an Unite be in the firſt Place, the fourth Term is obtain'd by the Multiplication of the ſecond and third Terms only; becauſe 1, or Unity, doth not divide. Alſo,

IF an Unite be in the ſecond or third Places, whereby Multiplication cannot be made, becauſe 1, or Unity, doth not multiply, then the fourth Term required

required is obtain'd by only dividing the ſecond or third Term by the firſt.

EXAMPLE I.

IF 25 Men are paid 252 *l.* for ſix Months Work, how much will 72 Men be paid for the ſame Time, and at the ſame Rate of Payment?

IN this Example 72 is the demanding Number, which I place for the third Term; and it being *Men*, therefore I make 25 my firſt Term, which is *Men* likewiſe, and then is my Queſtion truly ſtated; for when the firſt and third Terms are known, the ſecond is known alſo, being given; and the fourth likewiſe, when diſcovered by the Rule aforeſaid.

Men.		*l.*		*Men.*		*l.*
25	:	252	: :	72	:	725 $\frac{19}{25}$

```
      252
       72
      ---
      504
     1764
     ----
 25) 18144 (725
     175..
     ---
       64
       50
       --
       144
       125
       ---
        19
```

EXAMPLE II.

IF 1 Leaf of Gold will cover 16 ſquare Inches, how much will 100 Leaves cover?

HERE the Solution is made by Multiplication only; becauſe the firſt Term is an Unite.

Leave.		*Inches.*		*Leaves.*		*Inches.*
1	:	16	: :	100	:	1600

```
  100
   16
 ----
 1600
```

EXAMPLE III.

IF 11 Square of Flooring take up 120 Deals, how many are required for 1 Square?

HERE the Solution is made by Diviſion only; becauſe the third Term is an Unite.

Square.		*Deals.*		*Square.*		*Deals.*
11	:	120	: :	1	:	10 $\frac{10}{11}$

```
 11) 120 (10 10/11
     11
     --
     10
```

EXAMPLE IV.

If 19 Yards of Wainscoting cost 57 *s.* what will 37 Yards cost?

```
Yards.    Shill.    Yards.   Shill.
 19   :    57   ::   37   :   111
           37
          ----
          399
         171
         ----
     19) 2109 (111
         19..
         --
          20
          19
          --
           19
```

EXAMPLE V.

If 7 Rod of Brick-Work require 31500 Bricks, how many will 52 Rod require?

```
Rods.   Bricks.     Rods.  Bricks.
 7  :   31500   ::  52  :  234000
           52
        -----
        63000
       1575        Bricks.
       -------
    7) 1638000 (234000 the Answer.
       14.::
       --
        23
        21
        --
         28
         28
         --
          0
```

EXAMPLE VI.

If 5 Hundred of Lime cost 42 *s.* 6 *d.* what will 25 Hundred of Lime come to

Before this Question can be solved, I must reduce the 2 *l.* 2 *s.* 6 *d.* into Pence; whereby the Numbers will be of one Denomination, as in the Margin; where 2 *l.* 2 *s.* 6 *d.* is reduced to 510 *d.*

```
                 2 l.
                20
                --
                40 s.
Add              2
                --
Sum             42 s.
Multiply by     12 d.
               ---
               504
Add the          6 d.
               ---
               510 d. in 2 l. 2 s. 6 d.
```

Now

Now the Question is easily stated as follows:

If 5 Hundred of Lime cost 510 Pence, what will 25 Hundred cost?

```
Hund.  Pence.      Hund.   Pence.              l.   s.   d.
 5  :  510    : :   25  :  2550  equal to  10 : 12 ; 6
        25
       ----
       2550
       1020
      ------                      A  Shill.          B  Pounds.
   5) 12750(2550              12) 2550(212       20) 212(10
      10...                        24..               20.
      --                           --                 --
       27                           15                 12 s.
       25                           12
       --                           --
        25                           30
        25                           24
        --                           --
         0                            6 d.
```

1.) Here the Answer, or fourth Number, is 2550 Pence; which being divided by 12, as at A, is equal to 212 Shillings and 6 Pence remaining.

2.) Divide 212 Shillings by 20, as at B, and the Quotient is 10 Pounds 12 Shillings; which, with the 6 Pence remaining at A, makes 10 *l.* 12 *s.* 6 *d.* the Answer required.

EXAMPLE VII.

If 27 Feet of Marble cost 4 *l.* 14 *s.* 6 *d.* what will 75 Feet and $\frac{1}{4}$ cost?

Before this Question can be stated, I must bring the first and third Numbers into Quarters, because the demanding Number hath the Fraction $\frac{1}{4}$ annex'd to it. Also the second Number 4 *l.* 14 *s.* 6 *d.* must be reduced into Pence, as underneath.

```
 27                                         l.  s.  d.
  4                      75                 4  14  6
---                       4                 20
108 Quarters.           ---                 --
                        300                 80
   Add the Numerator      1                 14
                        ---                 --
                        301 Quarters.       94 s.
                        ---                 12
                                           ----
                                           1128
                                              6
                                           ----
                                           1134 d.
```

Now

Now state and work the Question as following:

Quarters.		*Pence.*		*Quarters.*		*Pence.*			*l.*		*s.*		*d.*
108	:	1134	: :	301	:	3160.	$\frac{54}{108}$	equal to	13	:	3	:	4.

1134 × 301:

301
1134
3402

108) 341334 (3160
324
173
108
653
648
54

A

12) 3160 (263 *s.*
24
76
72
40
36
4 *d.*

B

20) 263 (13 *l.*
20
63
60
3 *s.*

1.) HERE the Answer is 3160 Pence; which divide at 12, as at A, and the Quotient is 263 Shillings and 4 Pence remaining.

2.) 263 Shillings divided by 20, as at B, the Quotient is 13 Pounds 3 Shillings remaining; which, with the 4 Pence remaining at A, make 13 *l.* 3 *s.* 4 *d.* the Answer required.

EXAMPLE VIII.

IF 50 *l.* will purchase 25 Loads of Timber, how much Timber will 750 *l.* purchase?

Pounds.		*Loads.*		*Pounds.*		*Loads.*	
50	:	25	: :	750	:	375	the Answer.

750
25

50) 18750 (375
150
375
350
250
250

THUS far with Respect to the *Golden Rule Direct*; which you see is performed most easily by the Help of Multiplication and Division only. I shall in the next Place give you some Examples in

The GOLDEN RULE *Indirect.*

THIS Rule is called the *Indirect Rule of Proportion*, with Regard to its inverting the Practice of the Direct Rule: For as in the Direct Rule the second and third Numbers were multiplied together, and their Product divided by the

the firft Number; fo on the contrary, in this Rule the firft and fecond Numbers are multiplied together, and their Product divided by the third. And further, as in the Direct Rule, it was noted, that more required more, or lefs required lefs; fo on the contrary, in this Rule, more requires lefs, or lefs requires more. That is, if 20 Men in 3 Days eat 20 Quartern-Loaves of Bread, 40 Men muft needs eat the 20 Loaves in leffer Time, that is, in half the Time, becaufe double in Number. So here more Men require lefs Time to do the fame Thing.

AND contrary, if 10 Men have 20 Loaves to eat, in manner as aforefaid, they will require more Time, *viz.* 6 Days, becaufe they are lefs, but have the firft Number: So here lefs Men requires more Time to do the fame Thing.

EXAMPLE I.

IF 15 Men can perform a Piece of Work in 12 Days, how many Days will 12 Men be in performing the fame Work?

```
Men.   Days.    Men.  Days.
15  :   12   ::  12  :  15
        15
      ----
   12) 180 (15
        60
```

EXAMPLE II.

IF 11 Men build a Wall in 21 Days, how long muft 7 Men be to do the fame Work?

```
Men.   Days.    Men.  Days.
11  :   21   ::  7  :  33
        11
      ----
    7) 231 (33
       21
      ---
        21
        21
       ---
```

EXAMPLE III.

IF 33 Men perform a Work in 17 Days, how long will 25 Men be doing the ſame Work?

Men.		*Days.*		*Men.*		*Days.*
33	:	17	::	25	:	22 $\frac{11}{25}$

$$\begin{array}{r} 17 \\ 33 \\ \hline 25)\,561\,(22 \\ 50 \\ \hline 61 \\ 50 \\ \hline 11 \end{array}$$

EXAMPLE IV.

IF 72 Men begin and finiſh a Houſe in 45 Days, how long will 32 Men be doing ſuch another Work?

Men.		*Days.*		*Men.*		*Days.*
72	:	45	::	32	:	202 $\frac{1}{2}$

$$\begin{array}{r} 45 \\ 72 \\ \hline 32)\,6480\,(202 \\ 64 \\ \hline 080 \\ 64 \\ \hline 16 \end{array}$$

16 remain, or $\frac{16}{32}$ equal to $\frac{8}{16}$, equal to $\frac{4}{8}$, equal to $\frac{2}{4}$, equal to $\frac{1}{2}$.

IN all theſe Examples, leſs Men have required more Time; and in the following Examples, more Men will require leſs Time.

EXAMPLE V.

IF 21 Labourers can empty out 517 cubical Yards of Earth in 9 Days, how ſoon will 30 Labourers do the ſame Work?

Men.		*Days.*		*Men.*		*Days.*
21	:	9	::	30	:	6 $\frac{1}{3}$.

$$\begin{array}{r} 21 \\ 9 \\ \hline 30)\,189\,(6 \\ 180 \\ \hline 9 \end{array}$$

9 remains, equal to $\frac{9}{30}$, or $\frac{3}{10}$, or $\frac{1}{3}$.

EXAMPLE

EXAMPLE VI.

IF 32 Carpenters can frame and raiſe five Roofs in 11 Days, how long will 40 Carpenters be doing the ſame.

Men.	*Days.*		*Men.*	*Days.*
32	: 11	: :	40	: $8\frac{4}{5}$.

$$\begin{array}{r} 32 \\ 11 \\ \hline 40)\,352\,(8 \\ 320 \\ \hline \end{array}$$

32 remains equal to $\frac{32}{40}$, or $\frac{16}{20}$, or $\frac{8}{10}$, or $\frac{4}{5}$.

THESE Examples being well underſtood, I need mention no more: And therefore I ſhall juſt give you two or three Examples in the Golden Rule Compound, and ſo conclude this Lecture.

The GOLDEN RULE *Compound.*

THE Golden Rule Compound conſiſts of five Numbers given, to find out a ſixth in Proportion to them; wherein you muſt obſerve, That the three firſt Numbers may contain a Suppoſition, and the two laſt a Demand. Now, that you may place them right, obſerve, That the

$$\left.\begin{array}{l}\text{Firſt and Fourth}\\ \text{Second and Fifth}\\ \text{Third and Sixth}\end{array}\right\}\text{Terms, be of the ſame Denomination.}$$

SUPPOSE that the following was a Queſtion propoſed, *viz.* If 16 Men for 18 Weeks Servitude, are paid 136 *l.* what muſt 18 Men for 25 Weeks Servitude be paid? Place the Terms as following:

Men.		*Weeks.*		*l.*		*Men.*		*Weeks.*
16	:	18	:	136	: :	18	:	25, and then work by the following

RULE.

MULTIPLY the firſt and ſecond Numbers into themſelves; alſo the fourth and fifth Numbers, and note their Products ſeverally. This done, you may ſolve the Queſtion by the ſingle Golden Rule, making the Product of the firſt two Terms the firſt, the third Term the ſecond, and the Product of the fourth and fifth Terms the third Term: Then will the fourth Number proportional to them, be alſo proportional to the five given Numbers, and the Anſwer required.

As for Example.

The firſt Number	16	
The ſecond Number	18	
Product	1188;	which is the firſt Term.
The third Term	136	is the ſecond Term.
The fourth Number	18	
The fifth Number	25	
Product	2250;	which is the third Term.

THESE Numbers thus atttained, ſtate your Queſtion, as follows :

1188 : 136 :: 2250 : 257 : $\frac{684}{1188}$ *the Anſwer.*

Table.	
1188	1
2376	2
3564	3
4752	4
5940	5
7128	6
8316	7
9504	8
10692	9

```
          2250
           136
         -----
         13500
         6750
        2250
        ------
  1188) 306000 (257
        2376..
        ----
         6840
         5940
         -----
         09000
         08316
         -----
           684
```

Here the fourth Number produced, is 257 : $\frac{684}{1188}$; which is the Anſwer required; and is to be placed in your original Queſtion, as follows :

	Men.		*Weeks.*		*Pounds.*		*Men.*		*Weeks.*		*Pounds.*
If	16	:	18	:	136	: :	18	:	25	:	257 $\frac{684}{1188}$.

P. *I thank you, Sir, for the Trouble you have been at. I ſee that the Golden Rule, in all its Varieties, depend principally upon the true Stating of the Queſtion; in which I ſhall be very careful. But, Pray Sir, how ſhall I know when I have done right or wrong? That is, how muſt I prove my Work?*

M. IN the very Beginning of this Rule, I told you; and proved to you alſo, that the four Numbers are Proportionals. And therefore,

To prove the Golden Rule,

THE Square of the Means (that is, the Product of the ſecond and third Numbers multiplied into each other) is equal to the Square of the Extreams, that is, the Product of the firſt and fourth Numbers multiplied into themſelves.

IN

As for Example.

In this laſt Queſtion, The third Number is 2250 } which are
The ſecond Number is 136 } the Means.

```
      2250
       136
     -----
     13500
     6750
    2250
    ------
    306000 Square of the Means.
```

Product 306000 Square of the Means.

```
The firſt Number   1188
The fourth Number   257
                   ----
                   8316
                  5940
                 2376
                 ------
Product          305316
To which add        684 the Remainer after Diviſion.
                 ------
And the Total    306000 is equal to the Square of
                        the Extreams, and to
```

the Square of the Means before found; which is a Proof that your Work is true. But you muſt here obſerve, that this Manner of Proof holds good for no other kind of Queſtions, but ſuch as are direct Proportionals, *viz.* when of four Numbers, the firſt is to the ſecond, as the third is to the fourth: Therefore when Numbers happen indirect, that is to ſay, when the third Number is leſs than the firſt, and require more; or more, and require leſs; then the Product of your firſt and ſecond Numbers will be equal to the Product of the third and fourth.

EXAMPLE.

If 24 Men build a Column in 16 Days, in how many Days will 48 Men do the ſame Work?

```
   M.   D.     M.  D.
   24 : 16 :: 48 : 8
   16
   --
48) 384 (8  Anſwer.
    384
    ---
```

```
Now, here you multiply the firſt Number   24
             By the ſecond Number         16
                                         ---
                             Product     384

Alſo the third Number                     48
  By the fourth Number                     8
                                         ---
                                         384
```

Here you ſee that the Product of the firſt by the ſecond, is equal to the Product of the third and fourth; *which proves the Operation to be true.*

HAVING thus inſtructed you in the Principles of Vulgar Arithmetick, upon which Foundation our Superſtructure is to be raiſed, I ſhall, in the next Lecture, give you ſome Queſtions of *Arithmetical Proportions*, for your further Exerciſe: And after them, proceed to Geometry; and when that you have acquired a competent Knowledge therein, then I will inſtruct you in the Doctrine of *Vulgar Fractions*, *Decimal Arithmetick*, *Extraction of the Square and Cube Roots*, *Geometrical Progreſſion*, and *Logarithmetical Arithmetick*: For, as Geometry is the Real Baſis of all Arts, ſo it is impoſſible to well underſtand any one, without being firſt acquainted with the Principles thereof. And, indeed, though you may at firſt believe that Geometry is a Digreſſion from Arithmetick, yet you will find in the Practice thereof, that the one hath a very great Affinity to the other, or, if I may be permitted to ſay, they are both the ſame Thing: For, as Arithmetick expreſſes Numbers and Quantities by Characteriſticks or Figures, ſo likewiſe doth Geometry the ſame by Lines, Figures, and Bodies; and whatever is expreſs'd by Arithmetick, the very ſame are either Geometrical Lines, Figures, or Bodies; as will evidently appear in the following Sheets. Wherefore 'tis plain that *Arithmetick is Geometry*, or at leaſt a Branch or Part thereof, and not a Science or Art abſolute of itſelf, as many ſuppoſe it to be.

LECTURE VII.

On Arithmetical Proportion.

M. ARITHMETICAL Proportion is by ſome called *Progreſſion*, as being a continued Progreſſion or Series of Numbers, increaſing or decreaſing by equal Differences, or the continual Addition or Subtraction of ſome equal Number.

So 1, 2, 3, 4, 5, 6, 7, 8, 9, is a Rank of Numbers increaſing by the continual Addition of 1; and 9, 8, 7, 6, 5, 4, 3, 2, 1, is a Rank of Numbers decreaſing by the continual Subtraction of 1.

ALSO,

2, 4, 6, 8, 10, 12, 14, 16, 18, 20, are a Series of Numbers increaſing by 2 added to each preceding Number; and 20, 18, 16, 14, 12, 10, 8, 6, 4, 2, are Series decreaſing by 2, being ſubtracted from each preceding Number.

LIKEWISE

LIKEWISE,

1, 8, 15, 22, 29, 36, 43, 50, is a Series or Rank of Numbers increasing by the continual Addition of 7; and 100, 90, 80, 70, 60, 50, 40, 30, 20, 10, is a Series or Rank of Numbers decreasing by the continual Subtraction of 10.

P. *VERY well, Sir; I see by these Examples, that in every Series of Numbers, each Number is greater or lesser than the following, according to the Difference assigned them, be it* 1, 2, 3, 10, &c. *Pray what ensues?*

M. FIVE Things, or rather so many Considerations, *viz.*

First, The first Term, (which is generally the least.)

Secondly, The last Term, (commonly the greatest.)

Thirdly, The Number of Terms, or Places.

Fourthly, The equal Difference, (called the common Excess.)

Fifthly, The Sum of all the Terms taken together in total Aggregate.

P. *PRAY explain all these Considerations more fully.*

M. I WILL: Suppose the Series of Numbers following be given, *viz.* 1, 5, 9, 13, 17, 21, 25, 29, 33, 37, 41. Then the Number 1 is the first Term, (and the least also;) and the Number 41 is the last Term, and greatest. Again, the Number of Terms is 11, and the equal Difference is 4; because 1 and 4 make 5, and 4 make 9, and 4 make 13, and 4 make 17, *&c.* Lastly, The Sum of all the Terms taken together, is the total Aggregate; which in this Series of Numbers is 231, as in the Margin, where all the Numbers are added together, according to the common Method of Addition: But herein I shall shew you how to find the Total of any such Series of Numbers in a more concise Manner; and for the well understanding thereof, I shall, in the first Place, acquaint you with some necessary Theorems, for the better understanding of the following Problems.

$$\begin{array}{r} 1 \\ 5 \\ 9 \\ 13 \\ 17 \\ 21 \\ 25 \\ 29 \\ 33 \\ 37 \\ 41 \\ \hline 231 \end{array}$$

P. *PRAY what are Theorems and Problems?*

M. A THEOREM is a Proposition, wherein the Truth is consider'd only, without descending to the Practice thereof. But when we descend to the Practice, that is, when something is proposed to be done or made, then such a Proposition is called a *Problem.*

P. *THANK you, Sir: Pray proceed to the Theorems you just mentioned.*

M. I WILL, as follows.

THEOREM I.

ANY Term of an Arithmetical Progression is equal to the first Term added to the Product produced, by the Number of Places preceding it multiplied into

to the common Excefs : Or, if the common Excefs be multiplied by a Number that wants one of being equal to the Number of Places in the Progreffion, and to the Product thereof be added the leaft Term, the Sum is equal to the greateft Term.

DEMONSTRATION.

LET 3, 5, 7, 9, 11, 13, 15, 17, 19, 21. *be a given Series of Numbers in an Arithmetical Progreffion*; then I fay, any Number thereof, fuppofe 19, is equal to the firft Term, 3 being added to 16, the Product of the preceding Number of Places, 8 multiplied by 2 the common Excefs.

P. *PRAY what do you mean by the Number of Places preceding; and which are they?*

M. THE Number of Places preceding any Number given, is the Number of Places that are before it. So in the firft three Numbers of the above Series, 3, 5, 7. if 5 be a given Number, then the 3 preceeds it, that is, it is before it, and confifts but of one Place. And if 7 be a given Number, then the 3 and the 5 preceds it, and are two Places before it. And if the 9 was the given Figure, then there would be three Places preceding it, *viz.* the 3, the 5, the 7; and fo in like Manner to any other Term. Therefore,

IN the above Series the Term 19 is equal to 8, the Number of Places preceding it, multiplied by 2 the common Excefs, added to the firft Term.

THEOREM II.

IF three Numbers are in Arithmetical Progreffion, the Double of the Mean, or middle Number, is equal to the Sum of the Extreams, being added together.

DEMONSTRATION.

Let 10, 20, 30, *be the given Numbers:*

THEN I fay, that the Mean or Middle Term 20, being doubled, is equal to 40; and if the firft Term 10 be added to the laft Term 30, the Sum is equal to 40 alfo : And fo the like of any other three Numbers in Arithmetical Progreffion. Hence it follows,

THAT in any Arithmetical Progreffion, any Term doubled is equal to the Sum of any other two Terms, equally diftant on each Side from it.

DEMONSTRATION.

Let 1, 8, 15, 22, 29, 36, (43) 50, 57, 64, 71, *be a given Series:*

THEN I fay, that any Term thereof, fuppofe (the 7th Term, which is) 43, being doubled, (equal to 86) is equal to any other two Terms equally diftant on each Side from it, being added together; fo 36 and 50, added together, are equal to 86, the Double of 43. And in like manner 29 and 57, which

which are at equal Diſtances from 43, being added together, are equal to 86 alſo. And 15, which is four Places before 43, being added to ~~84~~ 87, which is four Places after 43, makes 86 likewiſe: And ſo of all other Numbers in Arithmetical Progreſſion, that are equally diſtant on each Side of the Number given.

THEOREM. III.

In any Series of Numbers, that are in Arithmetical Progreſſion, the Sum of any two Terms, taken in any Part thereof, is equal to the Sum of any other two Terms of equal Diſtance from them.

DEMONSTRATION.

Let 7, 14, 21, (28,) 35, 42, (49,) 56, 63, 70, *be a given Series.*

Then, I ſay, that the Sum of any two Terms, ſuppoſe 28 and 49, which added together, make 77, is equal to the Sum of any other two Terms of equal Diſtance from them. Suppoſe, the Terms 35 and 42, which are equally between them, be added togther, they make 77; or 21 and 56, the two outward Numbers next them, make 77; or 14 and 63, the next two outward, make 77; and ſo 7 and 70, which are the firſt and laſt, at three Places diſtant on each Side, make 77 alſo.

AGAIN,

Suppose, 42 and 49 be the two Terms taken together, making 91; then 35 and 56, the two next to them, make 91 alſo; as likewiſe doth 28 and 63, or 21 and 70.

Now from this Theorem, 'tis plain, that if four Numbers are, in Arithmetical Progreſſion, the Sum of the two middle Numbers, or two Means are equal to the Sum of the two Extreams: For if 35, 42, 49, and 56, be given Numbers, whoſe common Exceſs is 7, then the Sum of the two Means, 42 and 49, equal to 91, are equal to the Sum of the Extreams, 35 added to 56, equal to 91 alſo.

THEOREM IV.

1. In any Series of Numbers in Arithmetical Progreſſion, if the greateſt and leaſt Terms be added together, and their Sum multiplied by the Number of Terms, one Half of the Product is equal to the Sum of all the Terms.

DEMONSTRATION.

Let 2, 6, 10, 14, 18, 22, 26, 30, 34, *be a given Series*:

THEN I ſay, if 34, the greateſt, be added to 2, the leaſt Term, and their Sum 36 be multiply'd by 9, the Number of Terms, one half of the Product 324, which is 162, is equal to the Sum all the Terms taken together.

P. *How ſhall I be ſure that the ½ Product is equal to the Number of Terms taken together.*

M. *Place* them one under another, as in the Margin at A, and add them together according to the common Way of Addition, and their Total will be equal to the ½ Product, as before

A
2
6
10
14
18
22
26
30
34
162

Greateſt Term	34
Leaſt Term	2
Sum	36
Number of Places	9
	324
One half	162

P. *I have added them, and find the ſame; and thereby I ſee that Arithmetical Progreſſion is a real conciſe Method of Addition, by which a Series of many Numbers are moſt expeditiouſly added together in a pleaſant and eaſy Manner: Wherefore I pray you to proceed to further Practice herein.*

M. I WILL. And here obſerve, that if the Sum of the greateſt and leaſt Terms be multiply'd by half the Number of Terms, the Product is equal to the Sum of all the Terms.

DEMONSTRATION.

The Sum of the greateſt and leaſt Term	36
Half the Number of Places	4½
	144
	18
Product equal to the Sum of all the Terms taken together	162

AGAIN,

IF the half Sum of the greateſt and leaſt Terms be multiplied by the Number of Terms, the Product is equal to the Sum of all the Terms taken together.

DEMONSTRATION

DEMONSRATION.

Half of the greateſt and leaſt Terms is	18
The Number of Places	9
Product	162

Laſtly,

WHEN the Series conſiſt of an odd Number, as that before-going, then multiply the middle Number thereof, (which there is 18) by the Number of Terms, 9, and the Product is equal to the Sum of all the Terms required.

The middle Number	18
The Number of Terms	9
	162

THUS have I ſhewn you four ſeveral Ways of ſolving this Theorem, that are entertaining and uſeful, to prove the Truth by.

THEOREM V.

IN a Series of Natural Numbers, as 1, 2, 3, 4, 5, 6, 7, 8, 9, *&c.* if the laſt Term be multiplied by the next greater, one half of the Product is equal to the Sum of the whole Series taken together.

DEMONSTRATION.

Let 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, *be given to find the Sum of the Whole taken together.*

THEN, I ſay, if 20, the laſt Term be multiplied by 21, which is the next greater, one Half of the Product 420, which is 210, is the Sum of the whole Series required.

HERE, for Proof, I add together the given Series, divided, for Conveniency's ſake into two Parts; whoſe Totals added together, are equal to 210, the half Sum before produced.

1	11	The laſt Term	20
2	12	The next greateſt	21
3	13	Product	420
4	14	One Half	210
5	15		
6	16		
7	17		
8	18		
9	19		
10	20		
55	155		
	55		
	210		

THEOREM VI.

THEOREM VI.

In a Series of natural odd Numbers, 1, 3, 5, 7, 9, 11, *&c.* the Sum of the Whole is equal to the Square of the Number of Terms.

DEMONSTRATION.

Let 1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, *be the given Series, consisting of* 13 *Places, or Number of Terms:* Then I say, that 13
Multiplied by 13
Product is 169

Which is the Sum of the whole Series taken together; as appears by the same added together in the Margin at B.

1		15
3		17
5		19
7		21
9	B.	23
11		25
13		—
—		120
49		49
		169

THEOREM VII.

In a Series of natural even Numbers, the Sum of the Whole taken together, is equal to the Product of the Number of Terms, multiplied by the same Number, more one.

DEMONSTRATION.

Let 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, *be the given Series, consisting of* 13 *Places, or Number of Terms:* Then I say, that 13 multiplied by 14, which is the same Number, more one, the Product is equal to 182 equal to the Sum of the whole Series taken together, as is proved by their Addition at C in the Margin; where, for Conveniency's sake, I have divided them into two Columns, and added their Totals into one Sum; which you see is equal to 182, as before.

13	2		16
14	4		18
—	6		20
182	8		22
	10	C.	24
	12		26
	14		—
	—		126
	56		56
			182

THEOREM VIII.

In any Series of Arithmetical Progressional Numbers whatsoever, if the least Term be subtracted from the greatest, and the Remainder divided by the common Excess, the Quotient having Unity added to it, will be equal to the Number of Terms contained in the whole Series.

DEMONSTRATION.

DEMONSTRATION.

Let 4, 7, 10, 13, 16, 19, 22, 25, 28, 31, 34, *be the given Series.* Then I ſay, if from 34, the greateſt Term, be ſubtracted 4, the leaſt Term, and the Remainder 30, divided by 3, the common Exceſs, the Quotient is 10, to which add Unity, and it makes 11; which is equal to the Number of Places, or Terms required

THEOREM IX.

In any Series of Arithmetical Progreſſional Numbers whatſoever, if from the leaſt Term, the firſt Term be ſubtracted (as before in the laſt Theorem,) and the Remainder divided by the Number of Terms, leſs by one, the Quotient will be equal to the common Exceſs.

DEMONSTRATION.

Let 6, 11, 16, 21, 26, 31, 36, 41, 46, 51, *be the given Series, conſiſting of ten Places.* Then I ſay, if from 51, the greateſt Term, you ſubtract 6, the leaſt Term, the Remainder will be 45; which divided by 9, the Number of Places, or Terms, leſs one, (there being ten Places in the Whole,) the Quotient is 5; which is equal to the common Exceſs required.

From	51	the greateſt Term.
Subtract	6	the leaſt.
	9)45(5	the common Exceſs.

I shall now give you a few Problems for Practice; and ſo conclude this firſt Part.

PROBLEM I.

How many Strokes doth a Clock ſtrike, in ſtriking all the 12 Hours?

RULE. *By Theorem* V.

Multiply 12, the laſt Number, by the next greateſt Number 13, and half the Product thereof is the Anſwer required.

	12	the laſt Number.
	13	the next greateſt Number.
Product	156	
The Half	78,	the Number of Strokes in 12 Hours.

This Problem may be alſo perform'd by *Theorem* IV. as follows:

RULE.

Add the firſt and laſt Strokes together, which is 1 and 12, and they make 13; which multiply by half the Number of Terms, which here is 6, and the Product is the Anſwer required.

The firſt Number is	1
The laſt Number is	12
Sum	13
Half the Number of Terms	6
Product	78 as before.

PROBLEM II.

A HUNDRED *Stones are laid in a Right Line at* 1 *Yard asunder, which are to be collected together into a Basket by one at a time, how many Yards must a Man travel to gather them together.*

THIS Problem is to be solved by the last Rule of the foregoing Problem.

That is to say,

ADD the first Stone fetched in, (which the Man travels two Yards in doing, *viz.* one Yard from the Basket to the Stone, and one Yard back again,) unto the last Stone fetched in, (which the Man travels two Hundred Yards to perform, *viz.* one hundred Yards from the Basket to the Stone, and one hundred Yards back again,) and the Sum is 202; which being multiplied by half the Number of Terms 50, the Product is the Answer required.

The first Stone 2 Yards.
The last Stone 200

Sum 202
Which being multiplied by 50, half the Number of Stones.

Product 10100 Yards; which is the Answer.

THIS Problem may be solved by *Theorem* IV. as follows:

To the first Stone 2 Yards.
Add the last Stone 200

Their Sum 202
Which multiplied by the N° of Stones 100

Product 20200, of which take one Half.

Which is 10100, the Answer as before.

IF we divide 10100 by 1760 the Number of Yards in a Mile, the Quotient will shew the Number of Miles contained in 10100 Yards.

1760) 10100 (5 Miles.
8800

1300 Yards, which is three Quarters of a Mile, all but 20 Yards.

I WILL illustrate this by another Example: Suppose 200 Stones are laid at one Yard distance from each other in a Right Line, as the former, to be collected together by one at a time; how many Yards must a Man travel to perform that Work?

The first Stone is 2 Yards.
The last Stone is 400

Their Sum 402
Which multiply by 100, the half Number of Stones.

Product 40200, the Number of Yards required.

Now

5050
2
10100

202
50
10100

Now 40200 being divided by 1760, (as before,) the Quotient is 22 Miles $\frac{3}{4}$, and 160 Yards.

```
1760) 40200 (22 Miles.
      3520
      ----
       5000
       3520
      -----
       1480  Yards remaining.
      -----
Subſtract 1320  Yards, which is 3/4 of a Mile.
      -----
   And  160  Yards remain.
```

PROBLEM III.

An Architect travell'd from London *towards* Rome: *His first Day's Travel was ten Miles, his last Day's Travel was* 65 *Miles; he increaſed his Journey every Day five Miles: I demand how many Days did he travel, and the Number of Miles travelled?*

RULE I.

To find the Number of Days, (which is the Number of Terms,)

From laſt Day's Journey 65 Miles, ſubtract the firſt Day's Journey 10 Miles, the Remainder 55 Miles, divided by 5, the Number of Miles he increaſed his Journey every Day, which is the common Exceſs; the Quotient, more one, is equal to the Number of Terms, or Days, he travelled, *viz.* to 12, as in the following Operation.

```
From the laſt Day's Journey  65  Miles,
Take the firſt Day's Journey 10
                            ---
       Which divide by   5) 55 (11
To which add, more one,          1
                                ---
       The Sum is equal to      12, the Number of Days Travel.
```

The Number of Miles travelled is found by the Rules of the preceding Problem, as follows:

```
To the laſt Day's Journey    65  Miles,
Add the firſt Day's Journey  10
                            ---
              The Sum is     75
Which multiply by half the Days  6
                            ---
       And the Anſwer is    450  Miles; which is the Number of Miles
                                 he travelled in the Whole.
```

PROBLEM IV.

I have paid twelve Sums of Money: The firſt Payment I made was 5 l. *and the laſt was* 38 l. *which Payments increaſed in an Arithmetical Progreſſion: I demand, What was the common Difference of my Payments, and how much Money I have paid in the Whole?*

RULE.

RULE.

FROM the greateſt Sum paid 38 *l.* ſubtract the firſt Sum paid 5 *l.* the Remainder 33, divided by 12, the Number of Payments, leſs one, which is 11, the Quotient is 3, which was the common Difference of Payment.

From	38
Take	5
Divide by 11)	33 (3

NOW if to 38 *l.* the greateſt Payment, you add 5, the firſt and leaſt Payment, the Sums is 43 *l.* which multiplied by 6, the half Number of Payments, the Product is 258 *l.* as appears in the Operation following:

The firſt Payment	5 *l.*	
The laſt Payment	38	
Sum	43	
Multiplied by	6,	the half Number of Payments.
Product	258,	which is the Total Sum paid in the Whole.

PROBLEM V.

I BOUGHT 20 Blocks of Marble in Arithmetical Progreſſion: For the firſt I paid 24 l. *and for the laſt I paid* 120 l. *What did the Whole amount to?*

RULE.

ADD 24 *l.* the Value of the firſt Block, to 120 *l.* the Value of the laſt Block, and their Sum 144, multiply by 10, the half Number of Blocks, and the Product 1440 is the Anſwer required.

To	120 *l.*	
Add	24	
Their Sum	144	
Multiply by	10,	the half Number of Blocks.
The Product	1440	is the Total Sum paid in the Whole.

PROBLEM VI.

I AM to receive 987 l. *at* 14 *Payments, each Payment to exceed the former by* 7 l. *I demand the firſt Payment?*

RULE.

DIVIDE 987, the Total Sum to be received, by 14, the Number of Terms, or Times of Payment, and from the Quotient 70 ½ ſubtract half the Product produced by the Number of Terms, or Times of Receiving, leſs one, *viz.* 13 multiplied

13 multiplied by 7, the common Excefs, the Remainer is 25 *l.* which is the firft Payment required. In the firft Place, divide 987 by 14.

14) 987 (70 $\frac{7}{14}$, or $\frac{1}{2}$, the Quotient.
  98
  ——
  07

In the 2d Place, multiply, 13 the Number of Terms, lefs one, they being 14,
By 7 the common Excefs.

Product is 91
And the Half is 45 $\frac{1}{2}$; which being fubtracted from the Quotient 70$\frac{1}{2}$,
There remains 25 which is the Number of Pounds paid at the firft Payment.

From 70 $\frac{1}{2}$ the Quotient,
Take 45 $\frac{1}{2}$ the half Product of 13 multiplied by 7,

25 : 0 remains, the firft Payment required.

PROBLEM VII.

IN 8 Days Time I travelled 480 Miles; every Day's Journey was greater than the Day before by 4 Miles; and my laft Day's Travel was 79 Miles. I demand how many Miles I travelled the firft Day?

RULE.

MULTIPLY 4, the common Excefs, or Difference of each Day's Journey, by the Number of Days, lefs one, 7, and fubtract the Product 28 from 79, the Number of Miles travelled the laft Day, being the greateft Term, the Remainder 51 is the Number of Miles travelled in the firft Day.

Multiply	4	From	79
By	7	Take	28
	28		51 remains, the N° of Miles travelled in the firft Day.

NOW have I inftructed you in the firft Part of Arithmetick with Abundance of Satisfaction; and that you may, with equal Pleafure and Eafe, pafs through *Vulgar Fractions, Decimal Arithmetick, the Extraction of Roots, Geometrical Progreffion,* and the *Nature and Ufes of the Table of Logarithims*; I muft, in the next Place, make you a little acquainted with *Practical Geometry,* that you may well underftand the Reafon of every Operation contained therein; which, for want thereof, will be very difficult. To which I proceed.

THE

PRINCIPLES

OF

Ancient MASONRY:

OR, A

GENERAL SYSTEM

OF

BUILDING

COMPLEATED.

PART II. *Of GEOMETRY.*

By A—— A——.

M. AS Numbers are the Subject of Arithmetick, so Lines, Angles, Superfices, and Solids, are the Subject of Geometry: All which will be herein considered, so far as they relate to Practice, in the various Operations incident to the several Arts contained in this Work.

GEOMETRY is the very Basis of all Arts; and by a close Application, is soon and easily acquired.

To become a *Proficient* herein, *Thought* is required in our Reasonings and Reflections, on the various Effects of the several Schemes that we are to consider.

P. PRAY

P. PRAY *what do you mean by Thought, or Thinking, which I ſuppoſe to be the ſame Thing, and in what Manner is it performed?*

M. THIS is a Queſtion that few can anſwer; ſince there is not many in the World who give themſelves the Trouble of *Thinking:* But, however, as *thinking* is abſolutely neceſſary herein, I will therefore define to you what it is to think, and how 'tis perform'd.

The Manner of Thinking defined.

SINCE that we have no innate Idea's, therefore all Objects, or Materials for *Thinking,* muſt be firſt let in upon the Mind through the Organs of Senſe: That when they are ſo communicated, we may then reflect or reaſon upon them.

THAT is, when the Action of exterior Bodies ſtrike upon us, they at that Inſtant cauſe a ſecond Action internally, which is continued *in infinitum,* and differently named, as it affects the different Parts of our Bodies: that is, when it affects the Eye, 'tis called *Seeing*; when the Ear, *Hearing*; when the Palate, *Taſting*; and when the Noſe, *Smelling:* All which are no more than ſo many different Kinds of Feeling.

AS ſoon as either of theſe ſeveral Parts are thus affected by the Object, the Motion is continued farther, and inſtantly communicated to the Brain, where it cauſes that Effect, which is called *Thinking*; after which proceeds our Conſiderations, Determinations, Expreſſions, and Actions analogous thereto.

THUS it is by *Thinking* that the *Beauties of Geometry* are to be acquired; and for that End, the Definition of *Lines, Angles, Superficies,* and *Solids,* muſt be firſt let in upon the Mind, as *Materials or Objects of Thought*; which being well underſtood, will enable us to reflect and reaſon on their Properties when they come to act on one another, in their various and numberleſs *Theorems* and *Problems,* whoſe Effects are called DEMONSTATION; an Art that will herein be fully illuſtrated, to which many have pretended, and but few underſtood:

I SHALL herein purſue the ſame Method that *Euclid* obſerved in his Method of Teaching, as being the moſt familiar, conciſe, and inſtructive.

LECTURE I.

GEOMETRICAL DEFINITIONS.

M. THE Method of teaching Geometry, according to *Euclid,* was, *Firſt,* To define the moſt ordinary Terms. *Secondly,* To exhibit certain Suppoſitions; and then proceed to Propoſitions, wherein he treated of Lines, and the ſeveral Angles made by their Interſections, or Meetings; together with their Properties: All which he proved and demonſtrated, ſo as to convince any Perſon, who will conſent to nothing but what he ſhall be obliged to acknowledge. To which I ſhall annex, their various Uſes in the ſeveral Arts, whoſe Foundations they are.

P. Br

P. *By these I understand, that the Principles and Practice of Geometry, are comprized within three Terms that is to say, Definitions, Suppositions, and Propositions: Pray explain the Definitions of the most ordinary Terms?*

M. I WILL: And you are to observe, that the several Quantities of which Geometry treateth, are Points, Lines, Superficies, and Solids.

P. *What is a Point?*

DEFINITION I.

M. A POINT, according to *Euclid*, is that which hath no Parts; by which you are to understand, that what is but one, cannot be made two. Therefore any Quantity whatsoever, as an Inch, Foot, Yard, *&c.* may be considered a Point, provided you do not subdivide the same into Parts. But with regard to the smallest Quantity, and the Divisibility thereof, the most minute Atom has its Dimensions, and by the Mind may be subdivided into an infinite Number of Parts, which may be severally subdivided again *ad infinitum*: So that to determine the Bigness or Magnitude of the least material Point, is as difficult a Task, as to conceive Bounds to the Universe. Hence 'tis plain, that if a Point be materially consider'd, either infinitely small, or determinately large, as a Foot, *&c.* it doth consist of something, and therefore contains Matter; wherefore a material Point must be either a Superficies, or a Solid. In the Practice of Geometry, a Point is the least superficial Appearance that can be made by the Point of a Pen, Pin, Pencil, *&c.* as the Point A *Fig.* I. *Plate* I.

P. *What is a Line?*

DEFINITION II.

M. A LINE is a Length without Breadth or Thickness, which I thus prove: Suppose two Figures, as A and B, *Fig.* II. be differently colour'd, *viz.* that of A with red, and that of B with white Colour; then I say, that the Place *d c*, where the Edge of each Colour meet, or close one another, is a Line, or Length without Breadth or Thickness: And whereas in Practice we cannot draw a real Line, which hath not a determinate Breadth, we must therefore, to consider it strictly, consider one Side thereof only, that is, the very Edge or Meeting of the Colour of the Line on either Side thereof with the Colour of the Paper, *&c.* on which 'tis drawn. Hence it follows, that all Lines in Practice, though drawn never so fine and narrow, have Breadth, and consequently superficial Quantity; for otherwise they could not be visible to the Eye. But however, a Line is generally consider'd in Practice to be a Length, without making any Reflection on its Breadth, and as such 'tis to be understood.

P. *How many Kind of Lines are taught in Geometry?*

M. THREE, *viz.* Right Lines, Circular Lines, and Curved Lines.

P. *What is a Right Line; and how is it generated?*

DEFINITION

DEFINITION III.

M. A RIGHT Line, is a ſtraight Line, and the ſhorteſt of all the Lines that can be drawn between two Points; ſo the Line *d c*, *Fig.* II. is a Right Line, being the neareſt Diſtance between the two Points *d* and *c*. *Hence it follows, that the two Ends of a Line are Points*; and if the Point *d* be moved directly to the Point *c*, it will, by its Motion, trace or generate the right Line *d c*.

P. *I underſtand you very well: Pray now explain to me what is a circular Line; and how 'tis generated.*

DEFINITION IV.

M. A CIRCULAR LINE, is an arched Line, as *b c*, *Fig.* III. and is generated by the Motion of one End of a right Line, having the other End at the ſame Time fix'd: As for Example; Suppoſe the right Line *b a* have its End at *a* fix'd, and the other End *b* moveable; then if the End *b* be moved to *e*, thence to *c*, it will in its Paſſage trace or generate the ar[illegible] *b e c*. And again, if the Line *b a*, when 'tis arrived at *c a*, be carried [illegible] *d*, and from thence to *b*, the Place from whence it firſt came, it will ha[illegible] generated a compleat Circle; and becauſe that the Arch *b e c* is a Pa[illegible] the Circle *b e c d*, it is therefore called a Circular Line.

P. *And is all the arch Line from* b *to* e, *and from thence round about to* b *again, called a Circular Line?*

DEFINITION V.

M. No, that is called the Circumference of the Circle, although in Fact, it is a circular Line; and therefore you are to underſtand, that a circular Line may be either a Part, or the whole Circumference of a Circle; being diſtinguiſh'd by its Quantity, that is, when leſs than the Circumference, 'tis called an Arch; and when the Whole, the Circumference.

P *What is a curved Line?*

DEFINITION VI.

A CURVED LINE is any Line that is not a right Line; and therefore there are great Variety of curved Lines. As for Example; A circular Line is a curved Line, as not being a right Line; and ſo likewiſe is the Circumference of an Oval, as *a b*, *Fig.* IV. which, with regard to their being deſcribed at equal and regular Diſtances about their Centers, they are therefore called regular Curves; whereas ſuch as *c* are called irregular Curves, as not having any Reſpect to a Center.

P. *Pray, Sir, have not the various Kinds of curved Lines particular Names?*

DEFINITION VII.

M. YES: They are denominated according to the Nature of their Curvature or Bending. As for Example: Firſt, they may be circular, as *b e c d*,

Fig. III. Secondly, they may be ovaler, as *a b*, *Fig.* IV. Thirdly, they may be ſpiral, as *A*, *Fig.* IV. or ſerpentine, as *c*; or irregular, as *d*.

P. *I thank you, Sir, for this Account of the Names of curved Lines. Pray what am I to learn next?*

M. THE next in Order are *Angles*; which are generated by the Inclination or Meeting of Lines, and are of three Kinds, *viz.* Plain, Spherical, and Mix'd.

P. *Pray explain to me how an Angle is generated, or made?*

DEFINITION VIII.

M. I WILL, as follows: If a right Line, as *a b*, *Fig.* V. meet another right Line, as *c d*, on the ſame Plain or Level, and in a right-lin'd Poſition, they will at Meeting form a right Line; which will be equal to both their Lengths taken together: But when that two Lines meet one another in an oblique Poſition, as *e f* meets *h i* in the Point *g*, then they form an Angle. Therefore, according to *Euclid*, a plain Angle is the Opening of two Lines (in manner of a two-foot Joint-Rule partly open'd) that interſect, or meet each other, and which compoſe not one ſingle Line.

P. *I underſtand the Generation of an Angle, and what a plain Angle is. Pray, in the next Place, inform me what is a ſpherical Angle.*

DEFINITION IX.

M. A SPHERICAL Angle is an Angle compoſed of two circular or arched Lines, as the Angle *C*, *Fig.* VI.

P. *Pray why is it called Spherical?*

M. FROM a Sphere which is an Inſtrument made of divers Circles, repreſenting the imaginary Circles in the Heavens, (as the *Horizon*, *Meridian*, *Equinoctial Zodiack*, &c. of which you will be inform'd, when I come to teach the Art of Dialling; whoſe various Poſitions form divers Angles;) and therefore are called Spherical. The next Kind of Angles is the mix'd Angle, as *B*, *Fig.* VI. which is compoſed of a right Line *f i*, and arch Line *g i*, and therefore called Mix'd. So have I ſhewn you the various Kinds or Forms of Angles.

P. *Pray, Sir, is not there a Variety of Angles? For, I conceive that two Lines may meet each other, and form a great Diverſity of Openings, and thereby make many different Angles.*

DEFINITION X.

M. YOU obſerve very juſtly: For the Angle made by the Lines *b a*, *h a*, *Fig.* VII. may have the Line *h a* removed to *c a*, thence to *d a*, thence to *e a*, thence to *f a*; whereby at every Time as the Line *h a* is removed from its firſt Station, the Angle is increaſed or made larger. Hence you ſee 'tis evident, that the moſt open Angle is the greateſt, that is to ſay, when the Lines including an Angle, are farther aſunder than thoſe of another Angle taking them at the ſame Diſtance from the Points of Interſection of their Lines, the firſt is greater than the ſecond. So the Angle made by the Lines *b a* and *a f*, is greater

greater than the Angle made by the Lines *b a* and *a e*, by the Difference of the Angle made by the Lines *a e* and *a f*. For ſince that the Lines *b a*, *a e*, and *a f*, are all equal in Length, and ſince that the Diſtance of *b f* is greater than the Diſtance *b e*, therefore the Angle made by the Lines *b a*, and *a f*, is greater than the Angle made by the Lines *b a*, *a e*. So you plainly ſee, that the more open an Angle is, the greater it is made thereby.

P. *I underſtand what you ſay with relation to the Opening of the Lines, which undoubtedly increaſes the Angle; but how is it when the Sides of an Angle is continu'd out to a great Length? that is, ſuppoſe the Angles made by the Lines* a b, a d, Fig. VIII. *have its Side* a b *continu'd out to* c, *and Side* a d *to* e, *is not the Angle enlarged thereby?*

M. No: You miſtake the Thing entirely. The Quantity of the Angle is the ſame; as you will ſee by-and-by.

P. *Pray how do you determine the Quantity of Angles?*

M. ANGLES are determined according to the Quantity of the Degrees and Minutes contain'd in them.

P. *Pray what are the Degrees and Minutes?*

DEFINITION XI.

A DEGREE is the three hundred and ſixtieth Part of the Circumference of a Circle, be it great or ſmall, that is, if the Circumference of a Circle be divided into three hundred and ſixty equal Parts, one of thoſe equal Parts is called a Degree; and if the Magnitude of each Degree be large enough to be ſubdivided into 60 equal Parts, thoſe Parts ſo divided, are called Minutes: And though in ſmall Circles, it's not poſſible to divide a Degree into 60 Minutes, yet you muſt always conceive them ſo in your Mind, and underſtand every Degree, as if they were actually divided into Minutes.

Now that you may perfectly underſtand how the Circumference of a Circle is divided into Degrees and Minutes, and how by Degrees and Minutes the Quantity of an Angle is determined, I will in the next Place, before I proceed further in theſe Definitions, ſhew you how to divide the Circumference of any Circle into 360 equal Parts, or Degrees.

PROBLEM.

To divide the Circumference of a Circle into 360 equal Parts, or Degrees.

1. WITH any Opening of your Compaſſes deſcribe a Circle, as *a b d e*, *Fig.* IX. and through the Center *e* draw a right Line, as *b c*, which is called the Diameter, and divides the Circumference and Circle into two equal Parts, *viz.* *b a c*, and *b d e*, that are each called Semicircles.

2. OPEN your Compaſſes to any Diſtance greater than half the Diameter, and on the Point *b* deſcribe the Arches 2, 2, and 3, 3; alſo with the ſame Opening on *c*, deſcribe the Arches 4, 4, and 1, 1; interſecting the former in the Points 5 and 6, through which Points draw the right Line *a d*, which is a Dia-

a Diameter alſo, and divides each Semicircle into two equal Parts, that are called Quadrants.

3. TAKE half the Diameter *b e*, or *e c*, (which is called the Radius, or Semi Diameter,) and ſet it from *a* to *g*, and from *c* to *f*, and th[illegible] Arch *a c* of the Quadrant *e a c*, will be divided into three equal Parts.

4. DIVIDE *c g*, *g f*, and *f a*, each into three equal parts, and then will the Arch *a c* be divided into nine equal Parts.

5. DIVIDE each of thoſe nine Parts into two Parts, and each of them into five Parts, and then will the Arch or Quadrant *a c* be divided into ninety equal Parts or Degrees.

6. DIVIDE the other three Quadrants *b a e*, *b e d*, and *e c d*, in like manner, and then will the whole Circumference of the Circle be divided into three hundred and ſixty Degrees.

7. EVERY Degree, if your Circle is large enough, muſt be ſubdivided again, as before mentioned, into ſixty leſſer equal Parts, which are called Minutes: But ſince ſuch a Circle muſt be of a very large Diameter, therefore be contented to divide every Degree into as many Parts as you can, that is,

If each Degree be ſubdivided into	Parts, then each will repreſent	Minutes.
2		[illegible]
3		[illegible]
4		15
5		12
6		[illegible]

When the Circumference is thus divided, draw right Lines from every Degree in the ſame unto the Center *e*, whereon deſcribe two Circles at Pleaſure, as *n o*, *i h*, *z p k m*; and obſerve, that by the ſeveral Lines drawn from the Center *e*, to the Degrees in the Circumference, the Circumferences of the two inward Circles are divided into the ſame Number of Degrees, as the outward Circle, wherein the firſt Diviſion was made. And again, if the ſame Lines were to be continu'd out farther from beyond the outward Circle, their Number would not be increaſed, although they'd grow larger. Therefore you ſee, and muſt always well remember, that the leaſt Circle as can be imagin'd, contains the ſame Number of Degrees in its Circumference, as the very largeſt. This being underſtood, I will now explain to you the Manner of determining the Quantity of Angles.

P. *I ſhall be very thankful for the ſame; and hope ſoon to underſtand it, ſince I can divide the Circumference of any Circle into 360 Degrees, and each Degree into 60 Minutes.*

DEFINITION XII.

M. THE Meaſure of Angles, in general, are determined by the Quantity of Degrees and Minutes contain'd in the Arches which meaſure the ſame, that is, the Meaſure of the Angle made by the right Lines *a e*, and *e c*, is determined by the Quantity of Degrees and Minutes contain'd in the Arch *a f c*, or in the Arch *o x i*, or in the Arch *z r k*, which, in general, contain the ſame Number of Degrees, as before obſerved: So in like Manner, the Meaſure of the

the Angle made by the Lines *l e* and *b e* is determined by the Degrees and Minutes contain'd in the Arch *l b*, or Arch *g n*, or Arch *s p*.

Now *here obſerve*, that if the Lines *s e* and *p e* be conſider'd as an Angle, whoſe Meaſure is the Arch *s p*, and that the Side *e s* be continu'd out to *l*, and Side *e p* out to *b*, yet the Angle is not increaſed thereby; becauſe that the Arch *l b* contains but the ſame Number of Degrees as the Arch *s p*. Therefore you ſee, that you are miſtaken in thinking an Angle to be increas'd by the Continuation of its Sides.

P. *I underſtand you very rightly; and ſee plainly that the Continuation of the Sides of an Angle doth not increaſe it, as I once imagin'd it to do; and that every Circle contains the ſame Number of Degrees in its Circumference, that are leſſer or larger, according to the Magnitude thereof.*

I think, Sir, I have heard you ſay, that Angles are denominated according to the Quantity of Degrees they contain; pray, will you be pleaſed to inform me thereof?

M. I WILL: Angles are denominated, as you obſerve, according to the Number of Degrees they contain, and are of three Kinds, *viz.* Acute-angled, Right-angled, and Obtuſe-angled.

P. *What is an acute Angle?*

DEFINITION XIII.

M. ANY Angle that contains leſs than 90 Degrees, as the Angle made by the Lines *f e* and *e c*.

P. *What is a right Angle?*

DEFINITION XIV.

M. AN Angle that contains juſt a Quadrant, or 90 Degrees; as the Angle made by the Lines *a e* and *e c*.

P. *What is an obtuſe Angle?*

DEFINITION XV.

ANY Angle that contains more than 90 Degrees; as the Angle made by the Lines *b e* and *e f*.

And here note, that an Angle is always expreſſed by three Letters, of which, the ſecond or middlemoſt denotes the angular Point, as the Angle *b e f* is the Angle which the Lines *b e*, and *e f* form at the Point *e*.

DEFINITION XVI.

THE Complement of an Angle given, is another Angle, that being added thereto, make together either a right Angle, or a Semicircle: So the Angle *a e b*, *Fig.* X. being given, the Complement thereof is the Angle *b e c*; becauſe both thoſe Angles being taken together, make the right Angle *a e c*.

 Again,

Again, If the obtuse Angle *b e d* was given, then the Angle *b e a* would be the Complement thereof; because both taken together, compleat the Semicircle *a c d*. Hence you are to observe, that the Complement of an acute Angle, is so much as it is less than a right Angle; and the Complement of an obtuse Angle, is so much as it is less than a Semicircle.

Note, The Complements of Degrees in a Quadrant and Semicircle, are the same.

P. *Pray do Geometricians signify the Kinds of Angles by any particular Characters?*

YES: An acute Angle may be expressed thus ≥, a right Angle thus ∟, and an obtuse Angle thus _/; so likewise the Word Angle is expressed thus ∠, and Angles thus ⊿ ∠.

P. *I thank you for this full and plain Account of the Names and Nature of Angles. Now I must beg Leave to remind you of what I have often heard you speak of, relating to a perpendicular Line, which I desire you will define.*

DEFINITION XVII.

WHEN a right Line falling on another right Line, maketh the Angles on each Side equal, those Angles are right Angles, and the Line so falling, is called a Perpendicular: As for Example, *Fig.* X.

IF the right Line *c e*, falling on the right Line *a d*, make the Angles *a e c*, and *c e d*, equal, that is, if having on *e*, as a Center described a Semicircle *a c d*, and the Arches *a c*, *c d*, are then found equal, the Angles *a e c* and *c e d* are called right Angles, and the Line *c e* a Perpendicular: And because that the Arches *c d* and *a c* do each contain 90 Degrees, therefore the Semicircle *a c d* doth contain 180 Degrees, which is half 360.

HAVING now fully explained the Names and Kinds of Lines and Angles, I shall in the next Place, proceed to shew the like of the various plain Geometrical Figures that are form'd thereby.

P. *Pray how many plain regular Geometrical Figures are form'd by Lines?*

M. FOUR: *viz.* The *Circle*, the *Equilateral Triangle*, the *Geometrical Square*, and the *Polygon*.

P. *And are those all the Figures that can be formed by Lines?*

M. No: Besides these, there are various Kinds of *Ellipsis's* and *Ovals*, divers Kinds of *Triangles* and *Trapeziums*; also the *Parallelogram*, or *Oblong*, the *Rhombus*, and *Rhomboides*; also all the compound Figures that Invention can form: But of all these last, none are regular in their Sides and Angles, as the former are; so that they are deem'd irregular Figures, although some of their Parts are correspodently regular.

P. *Pray explain them severally; and be pleased to begin with the regular Figures; and first, of a Circle.*

DEFINITITION

DEFINITION XVIII.

M. I HAVE already ſhewn you, in the Generation of curved Lines, how by the Revolution of a right Line, a Circle is generated; and therefore I need now only add, to refreſh your Memory, that a Circle is a plain Figure, whoſe Bounds are made by the winding or turning of a Line, which is called *Circumference*, (as before obſerved,) and which is equally diſtant from the middle Point, that is called the *Center*.

DEFINITION XIX.

SECONDLY, That the *Diameter* of a Circle is any Line whatſoever which paſſeth through the Center, and which ends at the Circumference, cutting the ſame into two equal Parts.

DEFINITION XX.

THIRDLY, That half the Diameter is called the *Semidiameter*, or *Radius*.

DEFINITION XXI.

FOURTHLY, That a *Semicircle* is a Figure terminated by the Diameter, and half the Circumference; and a Quadrant, one half Part thereof.

P. *I thank you, Sir, for reminding me of a Circle, and the Lines thereof: But ſuppoſe that a Circle have a Part divided in it, as the Part* e c d, *Fig.* XI. *which is leſs than a Quadrant; pray what is the Name of ſuch a Figure?*

DEFINITION XXII.

M. THE Name of ſuch a Part of a Circle is called a *Sector of a Circle*; and is terminated under the two right Lines *c e* and *c d*, and the Arch or Curve *e d*; ſo likewiſe is *b x a e c*, a Sector alſo, terminated under the two right Lines *b c* and *c e*, and Arch *b x a e*.

P. *Very well, Sir; ſo far I underſtand you. But ſuppoſe that a Part of a Circle ſhould be divided off, as the Part* f g h, *Pray what's the Name of ſuch a Figure?*

DEFINITION XXIII.

M. WHEN a Circle is divided into two unequal Parts by a right Line, the Parts ſo divided, are called Segments of the Circle; ſo the Part *f g h* is the leſſer Segment of the Circle *b a d h*, and *f x e g* the greater Segment.

P. *And is the right Line* f g *called a Diameter, as the Line* b d *is?*

DEFINITION XXIV.

M. No: It is called a Chord Line: None are Diameters, as before obſerv'd, but ſuch that paſs through the Center.

P. *I ask Pardon for my Forgetfulneſs. Pray proceed; and explain to me the next regular Figure in Order, which I think you ſaid was the Equilateral Triangle.*

M.

DEFINITION XXV.

M. YES; the equilateral Triangle is the next plain Figure that is comprized under the next fewest Lines; that is, an equilateral Triangle is a plain Geometrical Figure, bounded by three right Lines, which are each equal to one another, as *a, b, c, Fig.* XIII.

P. *Pray, is there any particular Lines belonging to an equilateral Triangle, more than the Sides thereof?*

M. YES; perpendicular Lines, which may be drawn from any Angle to the Side opposite to it, as the Lines *b d, c e,* and *a h.*

P. *Pray, are all Triangles to be made equal in their Sides?*

M. NO; they may have two Sides equal, and the third unequal; as *i, l, k,* or every Side unequal, as *m, n, o*; but neither of these two last are regular Figures.

P. *That I know; and therefore beg Pardon and Leave for this Digression from our Discourse on regular Figures; which I am induced to desire, that in this Place, where you are speaking of Triangles, I may be fully informed in all the various Kinds thereof, and in what Manner they are severally distinguished.*

M. I WILL explain them severally to you. And, first, *Euclid* distinguisheth Triangles after two different Manners, *viz.* by their Sides, and by their Angles.

DEFINITION XXVI.

First, IF a Triangle have all its Sides equal, 'tis therefore called an *equilateral Triangle,* as before observed.

DEFINITION XXVII.

Secondly, IF two Sides are equal, and the third unequal, (either longer or shorter, as *l, i, k,*) it is called an *Isosceles Triangle.*

DEFINITION XXVIII.

And, *Thirdly,* IF every Side is unequal, as *m, n, o,* it is called a *Scalenum Triangle.*

THESE are the Distinctions of Triangles, with respect to their Sides. Now, with regard to their Angles.

DEFINITION XXIX.

First, IF a Triangle have one right Angle, as the Triangle *r p q,* it is therefore called a *right-angled plain Triangle.*

DEFINITION XXX.

Secondly, IF a Triangle have one obtuse Angle, as the Triangle *t s u,* whose Angle at *s* is obtuse angled, it is called an *Amblygonium Triangle.*

DEFINITION

DEFINITION XXXI.

Thirdly, IF a Triangle have all its Angles acute, as the Triangles *a, b, c*, or as *l, i, k*, it is called an *Oxygonium Triangle*. And theſe are the Diſtinctions of Triangles, with reſpect to their Angles.

P. *Pray are there any other Particulars to be known relating to the Sides and Angles of Triangles?*

DEFINITION XXXII.

M. YES; you are alſo to obſerve, *Firſt*, that in a right-angled plain Triangle, thoſe two Sides that form the right Angle, are called the Legs, as *r p*, and *p q*; and ſometimes one of them is called the Baſe, and the other the Perpendicular.

P. *Pray which of the two Legs is generally taken for the Baſe?*

M. THE longeſt, as *p q*.

P. *'Tis very reaſonable that the Baſe ſhould be the largeſt: Pray have you any Name for the other Line* r q?

M. YES: That is called the *Hypothenuſe*; and ſo the three Lines that form a right-angled plain Triangle, are the Baſe, Perpendicular, and Hypothenuſe.

P. *And are the Sides of all other Triangles thus denominated?*

M. NO; they are only diſtinguiſhed by calling any one Side (but generally the longeſt, as aforeſaid) the Baſe, and the other two Sides are always called the Sides oppoſite to the Baſe, either greater, equal, or leſſer, according to their Proportions, the one to the other. So in the Triangle *m n o*, if the Side *m o* be made the Baſe, then the Sides *m n*, *n o*, are the Sides oppoſite to the Baſe.

THESE are the Particulars to be obſerved, with reſpect to the Names of the Triangles. The next relating to the Nature, Quantities, and Affections of their Angles, I muſt refer unto Plain Trigonometry, wherein they are applied to immediate Practice.

P. *I thank you, Sir. Pray return to your Diſcourſe on the regular Figures, and excuſe this Digreſſion.*

DEFINITION XXXIII.

M. THE next regular Figure is the *Geometrical Square*, alſo called a Rectangle; which is a Figure bounded with four equal Sides, and all its Angles right, as *a, b, c, d*, *Fig.* XIV.

P. *Pray is there any particular Lines incident to the Geometrical Square?*

M. YES, there are two Kinds, *viz.* the *Diagonals*, and the *Diameters*.

P. *What are the Diagonal Lines of a Geometrical Square?*

DEFINITION XXXIV.

M. THOSE right Lines that are drawn from one Angle to the other, as *a d* and *b c*, and the Point *i*, where the two Diagonals interſect each other, is called the *Center* of the Square.

P. *What are the Diameters of a Geometrical Square?*

DEFINITION XXXV.

M. RIGHT Lines drawn through the Center from one Side to the other, making right Angles at meeting, as *g h* and *e f*. *Euclid* calls the Lines *a d*, *b c*, Diameters, inſtead of Diagonals; but, I think, very improperly. The next regular Figures, are the various ſorts of Polygons, namely, the *Pentagon*, *Hexagon*, *Septagon*, or *Heptagon*, *Octagon*, *Nonagon*, *Decagon*, &c.

P. *Pray what is a Pentagon?*

DEFINITION XXXVI.

M. A PENTAGON is a regular Figure bounded by five equal Lines, which conſtitute as many equal Angles, as A, *Fig.* 15. So in like manner a *Hexagon* conſiſts of ſix Sides, as B; a *Septagon*, or *Heptagon*, of ſeven Sides, as C; an *Octagon*, of eight Sides, as D; a *Nonagon*, of nine Sides, as E; a *Decagon*, of ten Sides, as F; an *Undecagon*, of eleven Sides, as G; a *Duodecagon*, of twelve Sides, as H, *&c.*

NOW from theſe you ſee, that regular right-lined Figures are terminated by Lines; as the Circle by one Line, the equilateral Triangle by three, the Geometrical Square by four, the Polygons by five, ſix, *&c.* And therefore it follows, That as a Term is the Extremity or End of a Quantity, ſo Lines are the Terms and Extremities of ſuperficial Figures, and conſequently a ſuperficial Figure, is a Quantity terminated and bounded on every Side by one or many ſuch Terms.

P. *What do you mean by the Word Superficies?*

DEFINITION XXXVII.

M. A QUANTITY to which is given Length and Breadth, without conſidering any Thickneſs, as a Shadow, *&c.* whoſe Extremities are Lines.

P. *PRAY is that Quantity round or flat?*

M. BOTH: A Superficies may be round, as the Surface of a Ball, and is then called a *convex Superficies*; or as the Inſide of a Baſon, and is then called a *concave Superficies*: Or it may be flat, or level, as the Face of a Table, *&c.* which laſt is called a *plain or ſtraight Superficies*, to which a right Line may be applied any Way. And it is ſuch Quantities that every Geometrical Figure contains.

P. *I UNDERSTAND you very well. Pray what are the Compound Geometrical Figures?*

DEFINITION XXXVIII.

M. THEIR Number are endleſs; but the principal ones that have Names, are, Firſt, The *Trapezia*, an irregular Figure, conſiſting of four unequal Sides, as

as I, *Fig.* XV. Secondly, the Rectangular *Parallelogram*, a Figure whose opposite Sides are parallel, and Angles right, (as in the *Geometrical Square*,) and differs from the Geometrical Square, in that, 'tis longer than broad; wherefore 'tis also called the *Long Square*, or *Oblong*, as K. Thirdly, the *Rhombus*, a Diamond-like Figure, having four equal Sides, as the Geometrical Square, but not right-angled; as L. Fourthly, the *Rhomboides*, which differs the same from the Rhombus, in Length only, as the Parallelogram differs from the Geometrical Square, whose opposite Sides and opposite Angles are equal, but hath neither equal Sides, nor right Angles, as the Figure M. *Here note*, That the *Altitude or Height of any Figure*, as the Rhomboides M, is a right Line drawn from the upper Part of it, perpendicular to the Base, as *aa* to *mo*; so also *nn* is the Height of the Triangle *nmo*. Lastly, N is an irregular Figure, bounded by many Lines; of which there's no End of Kinds.

HAVING thus defined the most ordinary Terms, you are, in the next Place, to observe the following

SUPPOSITIONS.

It is supposed,

1. THAT a right Line may be drawn, from any Point given, to any other assign'd; and afterwards, if required, be infinitely continued.

2. THAT on a given Point, an Arch or Circumference of any given Circle may be described with any Semi-Diameter or Radius taken between your Compasses. These being understood, we'll now proceed to Practice.

LECTURE II.

GEOMETRICAL PROBLEMS. Plate II.

PROBLEM I.

To make a Scale of equal Parts, representing Inches, Feet, Yards, Poles, &c.

FIG. I.

PRACTICE. First, Draw a right Line by the Side of your Rules at Pleasure, as *ab*; and thereon, from the End *a*, prick off ten equal small Divisions, as at 9. 8. 7. 6. 5. 4. 3. 2. 1. taking Care that whilst you are setting them off, you do not open or shut your Compasses, and thereby make unequal Divisions.

Secondly, Take the Length of those ten small Divisions in your Compasses, and set that Distance from *x* to 10, from 10 to 20, and from 20 to 30; and so on in like manner to 100, &c. when the Length of your Line is of a sufficient Length. This done, if each of the small Divisions represent an Inch, then the whole represents 30 Inches; or 30 Feet, if each small Division be made to signify a Foot.

P. *Pray*

P. *Pray why is a Line thus divided called a Scale? and what is its Use?*

M. As a Scale wherein Weights are put, discover or measures how many Ounces, Pounds, Hundreds, &c. are contained in any unknown Weight compared therewith; so a Line being divided as above, discover or measures how many of its Parts are contained in any given Line; and therefore is called a Scale.

As to its Use, I shall make it familiar in the following Problems.

PROBLEM II.

To draw right Lines, of any determinate Lengths, representing any Numbers of Inches required,

'Tis required to draw three right Lines, *viz.* one of 17 Inches, one of 24 Inches, and the third of 31 Inches in length.

Practice. First, Draw three right Lines at Pleasure, as *df*, *gn*, *hk*; then, applying to your Scale, set one Foot of the Compasses on 10, and open the other unto 7, which Distance set on the given Line *df*, from *d* to *e*; then will *de* represent a Length of 17 Inches. Secondly, Apply one Foot of your Compasses to 20 on your Scale, and extend the other to 4; which Distance set on the Line *gn* from *g* to *i*; so will *gi* be equal to 24 Inches. Thirdly, In like manner, apply one Foot of your Compasses from 30 to 1, and transfer that Length on the Line *hk* from *h* to *k*; then will those three Lines represent the three given Lengths as required: And so all others in like manner. I shall now shew you

How to measure the Length of any given right Line, by the Scale of Inches.

Let the right Lines *mm*, *pp*, be given, to find their Length in Inches.

Practice. Take the Length of the Line *mm* in your Compasses, and applying one Foot thereof to 10, the other will fall on 9; wherefore the Length of *mm* is 19 Inches. In like manner *pp* will be found to contain 14 Inches.

P. *Sir, I understand you very well, and am able to lay down on a given Line any Number of Inches required, and also to find how many Inches are contained in any given Line. But suppose that I am required to express Feet and Inches, or find how many Feet and Inches are contained in a given Line, pray how am I to perform the same?*

M. As follows.

PROBLEM III.

To make a Scale of Feet and Inches, and to draw right Lines, representing any Lengths thereof required.

FIG. II.

Practice. First draw at pleasure a right Line, as *ab*, and from the Left Hand end at *a*. Set off with your Compasses twelve small Divisions, as those expressed at 12. 11. 10. 9. 8. 7. 6. 5. 4. 3. 2. 1. representing so many

many Inches, or rather the Number of Inches in one Foot. Secondly, Take the Length of the twelve Divisions in your Compasses, and set it from *c* to *d*, from *d* to *e*, and from *e* to *f*; then will *cd*, *de*, and *ef*, each represent one Foot; that is, *cd* is one Foot, *c e* two Feet, and *cf* three Feet. Which may be continued on to any greater Number of Feet required, as to 10, &c.

HAVING thus prepared your Scale of Feet and Inches, you may represent right Lines of any Number of Feet and Inches required.

EXAMPLE.

'Tis required to represent two right Lines, the one of 2 *Feet* 11 *Inches, and the other of* 1 *Foot* 5 *Inches in Length.*

PRACTICE. Apply one Foot of your Compasses at *e*, and extend the other to 11; then that Length being transferred to a right Line, as *xi*; from *x* to *h*, will represent 2 Feet and 11 Inches. In like manner, take 1 Foot and 5 Inches in your Compasses, and transfer that Distance on the right Line *zl*, from *z* to *k*; then will *zk* represent one Foot 11 Inches, as required.

I SHALL now shew you

How to measure the Length of any given right Line by the Scale of Feet and Inches.

LET *fo* and *gp* be two given Lines, to find their Lengths severally in Feet and Inches.

PRACTICE. Take the Line *fo* in your Compasses, and applying it to the Scale, it will reach from 3 Feet to 7 Inches, the Length required. In the same Manner, the Line *gp* will be found to contain 3 Feet 11 Inches and half.

PROBLEM IV. Fig. III.

To describe the equilateral Triangle aeb, *whose Sides shall be respectively equal to the given right Line* ab, 5 Feet.

PRACTICE. First, Take five Feet, the Length of the Line *a b*, in your Compasses, and on the Points *a* and *b*, as two Centers, describe the Arches *d b* and *ac*, intersecting each other in the Point *e*; from whence draw the two right Lines *eb* and *ea*, which will complete the equilateral Triangle, as required.

P. *Pray what do you mean by the Arches* db *and* ac, *intersecting each other in the Point* e?

M. INTERSECTIONS of Lines, be them either right or circular, is when two Lines cut or cross each other; and the Point wherein they meet (as herein at *e*) is called the Point of Intersection: So likewise the right Lines *fg* and *ih* intersect each other in the Point *z*.

P. *Pray how do you prove that the Triangle* aeb *is equilateral?*

M. AS following: Since the Arches *db* and *ac* are described on the Extremes of the given Line *a* and *b*, and having their Radius's each equal thereto,

to, they must therefore interfect each other in *e*, at an equal Distance from *a* and *b*, the Extremes of the given Line; and therefore the Sides *ae* and *eb*, are each equal to the given Line *ab*, and the Triangle *aeb* equilateral: *Which was to be proved.*

PROBLEM V. Fig. IV.

To divide into two equal Parts a right-lined Angle given, as bae.

PRACTICE. On the angular Point *a* defcribe an Arch of any Radius, as the Arch *bfe*, and draw the Line *be*, upon which (*by the laft Problem*) make the equilateral Triangle *bde*: Draw the right Line *ad*, and it fhall divide the given Angle *bae* into two equal Parts, as required.

DEMONSTRATION.

SINCE *ab* is equal to *ae*, alfo *bd* equal to *ed*, and the Line *ad* is common to the Triangles *bad* and *ade*, therefore the Triangle *bad* is equal to the Triangle *ade*; and confequently the Angle *bad*, is equal to the Angle *dae*; wherefore the Angle *bae* is divided into two equal Parts: *Which was to be done.*

Note, *An Angle may be divided into two equal Parts, without regard being had to making an equilateral Triangle, as aforefaid: For if on the Points* b *and* e, *with any Opening of your Compaffes, greater than half* be, *you defcribe Arches to interfect each other, as the Arches* xx *and* zz, *interfecting each other in* r, *or the Arches* ww *and* nn, *interfecting each other in* m; *and from either of thofe Points of Interfection, you draw a right Line to the angular Point, that Line will divide the Angle into two equal Parts, as before.*

PROBLEM VI. Fig. V.

To bifect a right Line, as *ab*.

P. *What do you mean by bifecting a right Line?*

M. To bifect a right Line, is to divide it into two equal Parts at once, and that by an infallible Method, as following;

PRACTICE. By the firft Problem, make two equilateral Triangles, as *aeb* and *afb*, above and below the given Line, fo that the given Line may be common to both Triangles, and draw the right Line *ef*, which will bifect or divide the given Line *ab* into two equal Parts, as required.

DEMONSTRATION.

1. THE Triangles *aeh* and *ehb* have the Side *eh* common to them both, and the Sides *ea* and *eb* are equal, becaufe that the Triangle *eab* is equilateral.

2. THE Angles *aeh* and *heb* are equal, becaufe the Line *ef*, (by the laft Problem) divides the Angle *aeb* into two equal Parts, and confequently divides the Line *ab* into two equal Parts alfo. *Which was to be done.*

PROBLEM VII. Fig. VI.

To erect a Perpendicular (as dc) *from a given Point, (as* c,) *in or near the Middle of the given right Line* ab.

PRACTICE. First, with any Opening of your Compasses, set off on each Side the given Point *c*, any Distance, as *ce* and *ef*, which be careful to make equal to each other. Secondly, On the Line *fe*, (*by Problem* I.) erect the equilateral Triangle *fde*, and from the angular Point *d*, to the given Point *c*, draw a right Line *dc*; which will be the Perpendicular required.

DEMONSTRATION.

THE Triangles *fdc*, *bcd*, having the Side *cd* common to them both, and the Sides *fd* and *db* being equal, also *fc* equal to *ce*, therefore the Triangle *fdc* is equal to the Triangle *cde*: And because that *fc* is equal to *ce*, and *fd* equal to *de*, therefore *dc* is perpendicular to *ab*. *Which was to be demonstrated.*

Note, *A Perpendicular may be raised from a given Point, as aforesaid, by only opening your Compasses to any Distance greater than* ce *or* fc, *and on the Points* f *and* e, *describe Arches over the given Point, as* gg *and* ff, *intersecting each other in* h: *Then drawing the right Line* hc, *it will be the Perpendicular required.*

PROBLEM VIII. Fig. VII.

To erect a Perpendicular (ib) *at the End of a right Line* (ab.)

PRACTICE. 1. On the given Point *b*, with any Opening of your Compasses, describe an Arch at pleasure, as *ck*; and thereon from *c*, set up the Radius twice, *viz.* from *e* to *d*, thence to *h*.

2. ON the Points *d* and *h*, with the Distance *dh*, or any other that's greater, describe Arches as *df* and *he*, intersecting each other in *i*.

3. DRAW the right Line *ib*, and 'tis the Perpendicular required.

☞ SOMETIMES in Practice it happens, that the End of the given Line is so near to the Edge of the Paper, that the Point *h* can't be had thereon: Therefore, in such Cases, you may raise a Perpendicular by either of the three following Rules.

RULE I. Fig. VIII.

Let ac *be the given Line, and* c *the given Point.*

PRACTICE. 1. On the given Point *c*, with any Opening of your Compasses, describe an Arch at pleasure, as *bdx*, and make *bd* equal to the Radius *bc*.

2. ON the Point *d*, with the Distance *db*, describe the Arch *befgh*, and set the Radius Three times up the same from the Point *b*, as from *b* to *e*, thence to *f*, and thence to *g*.

3. FROM the Point *g* to the given Point *c*, draw the Perpendicular required.

RULE

RULE II. Fig. IX.

Let ab *be the given Line, and* b *the given Point.*

PRACTICE. 1. Open your Compasses to any Distance, and fixing one Foot in the Point *b*, pitch down the other at random, (in any Place that lies between the given Line and where the Perpendicular will happen,) as at *d*: Then keeping your Compasses at the same Opening as before, and having one Foot placed in *d*, with the other intersect the given Line by the Arch *cc* in *o*, and likewise describe the Arch *ee* over the given Point *b*.

2. LAY a Ruler from *o* to *d*, and it will intersect the Arch *ee* in *h*.

3. DRAW *hb*, and 'tis the Perpendicular required.

RULE III. Fig. X.

Let am *be the given Line, and* m *the given Point.*

PRACTICE. 1. Draw a right Line at pleasure, as AB.

2. TAKE three Inches from the Scale of Inches in your Compasses; and setting one Foot on the given Point *m*, with the other describe an Arch above the same, as *oo*.

3. TAKE 4 Inches, and set them on the Line *am*, from the given Point *m* to *c*; also take 5 Inches, and setting one Foot of your Compasses in *c*, with the other intersect the Arch *oo*, in the Point *i*. Lastly, draw the right Line *im*, and 'twill be the Perpendicular required.

☞ *I shall demonstrate this Problem hereafter, in my Lecture on the Transformation and Equality of Geometrical Figures, when the Manner of extracting the square Root is known to you.*

NOTE, This Method of raising a Perpendicular, is very useful in setting out the Foundations of Buildings: For being provided but with three Rods, *viz.* the one of 3 Feet, the second of 4 Feet, and the third of 5 Feet in Length, you may readily form a square Angle at one Operation, as following:

SUPPOSE CF, *Fig.* XI. to be Part of a Foundation, *&c.* and 'tis required to raise a Square or Perpendicular from the Point F.

FIRST, Lay your 4 Foot Rod from F, along the Line FC towards C; then take the other two Rods, and apply their Ends to the Ends thereof, as at D and F, observing that the 3 Foot Rod be always at the given Point F; and their other Ends being brought together at E, the 3 Foot Rod will then be the Perpendicular required.

NOTE, *That as a* 10 *Foot Rod is the most general in Practice, you may, instead of the Numbers* 3, 4. *and* 5, *make use of these Numbers doubled,* viz. 6, 8, *and* 10, *and with them proceed as before.*

BY this Method, you may not only very readily set out a square Angle of a Building, *&c.* but you may also examine Angles that are already built, if they are truly square, or not.

PERPENDICULARS

PERPENDICULARS may be raiſed inſtrumentally two Ways, *viz.* by the Scale of Chords, and by the Help of a Protractor.

P. *Pray what is the Scale of Chords ?*

M. THE Scale of Chords, is the Degrees contained in a Quadrant, or quarter Part of the Circumference of a Circle, transferred unto a right Line, as you may ſee in *Fig.* XII. where the Degrees in the Quadrant *cd* are transferred unto the Diameter *ad*, as following :

YOUR Quadrant *cd* being divided into 90 Degrees, as before taught in he firſt Lecture hereof ſet one Foot of your Compaſſes in *d*, and extend the other on the Arch to 10 Degrees. Then with that Opening, remove the ſaid Point away, until it fall upon the Diameter at *b* ; then will *bd* of the Diameter ſignify 10 Degrees, as the Part of the Quadrant *d* 10 doth. Again, ſetting one Foot of your Compaſſes in *d*, as before, extend the other on the Arch to 20 Degrees ; which Opening or Extent ſet on the Diameter, from *d* to 20, as before ; then will *d* 20 on the Diameter, ſignify 20 Degrees, in the ſame manner as *d* 20 on the Arch doth : Proceed on in like manner with every Degree in the Arch, and ſo will you have transferred the 90 Degrees in the Arch *cd* of the Quadrant *ecd*, unto the right Line, or Diameter *ad*, as repreſented in Fig. XIII.

☞ *And here obſerve, That* 60 *Degrees taken on the Arch* cd, *is exactly equal to the Radius, or Semidiameter* ed.

P. *And are* 60 *Degrees of any Circle always equal to the Radius or Semidiameter thereof ?*

M. YES ; and therefore, before your Perpendicular can be raiſed, or any other Work done, you muſt always firſt take 60 Degrees from your Line of Chords, and with that Diſtance deſcribe an Arch on the given Point. As for Example ; I would raiſe the Perpendicular *dc* on the right Line *ab*, from the Point *c*.

PRACTICE. Fig. XIV.

1. TAKE 60 Degrees in your Compaſſes from your Line of Chords, and on the given Point *c*, deſcribe an Arch at Pleaſure up from the given Line, as *edf*.

2. TAKE 90 Degrees in your Compaſſes, and ſet them from *e* to *d*, and then drawing *de*, it will be the Perpendicular required.

P. *I thank you, Sir ; 'tis very eaſy. Pray proceed to ſhew me, how to perform the ſame by the Inſtrument, which you call a Protractor : But in the firſt Place, pray what is a Protracter ?*

M. A PROTRACTOR is a Semicircle made of Ivory, or more generally of Braſs ; as *Fig.* XV. whoſe Circumference is divided into Degrees, and half Degrees, and ſometimes to Quarters, or 15 Minutes, by Help of which Inſtrument, you may moſt readily raiſe a Perpendicular from any given Point, at one Operation, as following :

To raise a Perpendicular by Help of a Protractor, Fig. XVII.

LET *f* be a given Point in the right Line *eg*, and 'tis required to raise a Perpendicular therefrom.

PRACTICE. Apply the Center of the Protractor *d* to the given Point *f*, with the inward Edge *ik*, exactly to the given Line *eg*; and, at the same Time, with a Pin, Pencil, &c. make a Point on your Paper, close by the Edge of your Protractor, exactly at 90 Degrees. Then removing away your Protractor, draw a right Line from that Point unto the given Point *f*, and it will be the Perpendicular required.

NOW you see, that these two last Methods are much the same, excepting that here in this last, you have no need of a Pair of Compasses to describe an Arch, because the Protractor is the Arch itself. But by the way, I must remind you, that on all Lines of Chords there are, or should be, two Brass Studs fix'd in the Line, the one at the Beginning thereof, and the other at 60 Degrees; which are there fix'd for your better applying your Compasses to the Line, when you want to take off the Radius, or any other Number of Degrees and Minutes required, without sticking them into the Rule, and thereby deface and spoil the Divisions.

THESE Instruments are generally made and sold by Mathematical Instrument-Makers, and are commonly included amongst those that are made up into Cases, for the Use of Mathematicians, and all others who delight in Drawing, Designing, Measuring, *&c.*

P. *Pray, what are those Instruments that are made into Cases; and of whom can I purchase them?*

M. THE Instruments that are proper for your Purpose, are *two Pair of Compasses*, about six Inches in Length; of which one Pair hath one of its Feet made to take out, and in its Place screw in another, either with a *Black-lead Pencil* in it, or a *Drawing-Pen*; whose Uses are to describe Arches or Circles, in Black-lead or Ink. Sometimes there is a third Point added, with a small Wheel, to describe pricked or dotted Lines, and is called the *Wheel-Point*: But as Ink is subject to receive Hairs, and other Impediments, that oftentimes causes it to run into an entire Line, and thereby spoil or deface many times an elaborate Drawing; therefore I advise you not to make any Use thereof, and in its stead take Time, and draw your prick'd or dotted Lines as neat as you can with your Hand Drawing-Pen: Which is another Instrument of the Case; whose Use is to draw right Lines of any Breadth or Fineness required, which you regulate by a Screw that's fix'd in the Chops of the Pen for that Purpose. Besides these, there are, first, a *plain Scale*, which is made either of *Box*, *Ivory*, *Brass*, or *Silver*, on which is graduated Varieties of *Scales of equal Parts*, and generally two different *Lines of Chords*. Lastly, a *Sector*, which opens to a Foot; on which is described the Lines of *Sines*, *Tangents*, *Secants*, *Numbers*, *Polygons*, &c. whose several Uses I shall hereafter make known unto you in their proper Places. These with good *Black-lead Pencils*, *Ink*, *Paper*, *Drawing-Board*, *Te-Square*, and two or three Rulers of different Lengths, as a Foot, eighteen Inches, two Foot, *&c.* are fully sufficient for your present Purpose.

These, and all other Mathematical Instruments, are most accurately made and sold, at very reasonable Rates, by Mr. THO. WRIGHT, Instrument-Maker

to his Majesty, at the *Orrery* in *Fleet-Street*; and Mr. DANIEL SCATLIFF, near *Bell Dock* in *Wapping*.

P. *I observed that just now you mentioned a Drawing-Board and Te-Square; pray what are they? and what are their Uses?*

M. A DRAWING-BOARD, is a square Board, made of Mohogony or Wainscot, about 15 Inches wide, and 20 Inches in Length, or any Size that the Largeness of the Paper you make use of requires. To this is belonging a Square, as *m*, Fig. XVI. Plate III. made in the Form of the Letter T, and therefore is called a *Te-Square*. About the Edge of the Drawing-Board is made a Groove, wherein the Stock *m* of the Te-Square slides when in use. Now, to make use of the Board and Square, you first fasten on your Paper with Sealing-wax, and then applying your Square to either Side, you draw by the Edge thereof any Line required. As for Example:

At the Point *h*, draw the right Line *e k*.

PRACTICE. Apply the Stock of the Square *m* against the End *ac*, or *bd*, and move the Tongue *n*, until the Edge thereof lie over the given Point *h*; then by the Side of the Square, draw the Line required.

EXAMPLE II.

From the Point *h*, on the Line *ek*, raise the Perpendicular *lh*.

PRACTICE. Apply the Stock of the Square to the Side *cd*, or *ab*, and slide the Edge of the Tongue of the Square *n*, until it lie over the given Point *h*; then by the Edge of the Square, draw the Perpendicular *lh*, as required.

PROBLEM IX. Fig. XVIII.

To erect a Perpendicular upon a convex Line, from a given Point, in or near the Middle thereof, as dg *on* adb.

PRACTICE. 1. Set off any Distance, equally on each Side the given Point, as *ce*, and thereon, with any Opening greater than *cd*, describe Arches; as *hh*, and *kk*, intersecting each other in *f*.

2. DRAW *fd*, and 'tis the Perpendicular required.

PROBLEM X. Fig. XIX.

To erect a Perpendicular upon a concave Line, from a given Point, in or near the Middle thereof, as df *on* adb.

PRACTICE. Set off *ce*, as in the last Problem, and likewise describe the Arches *gg* and *hh*, intersecting in *f*. Draw *fd*, and 'tis the Perpendicular required.

PROBLEM XI. Fig. XX.

To erect a Perpendicular upon a concave Line, from a given Point, at the End thereof, as ab *on* fb.

PERPENDICULARS

PRACTICE. 1. Assume 3 Points in the concave Line at pleasure, as the Points *h*, *e*, *n*, and draw the right Lines *he*, *en*; which Lines, by Problem VI. hereof, bisect by the Lines *ag* and *ae*, and continue them until they meet in *a*.

2. DRAW the right Line *ab*, and 'tis the Perpendicular required.

PROBLEM XII. Fig. XXII.

To raise a Perpendicular on the Angle of an Equilateral or Isosceles Triangle, as he, *on the Angle* acb *of the Triangle* cab.

PRACTICE. 1. On the given Point *c*, with any Opening of your Compasses, describe an Arch as *df*, interfecting the Sides *ac* and *cb*, in the Points *e*, *g*; on which, as two Centers, with any Opening of your Compasses, describe Arches over the Angle, as *ik*, and *lm*, interfecting each other in *h*.

2. DRAW the Line *hc*, and 'tis the Perpendicular required.

PROBLEM XIII. Fig. XXI.

To let fall a Perpendicular from a given Point, upon a right Line assigned; as lk, *from the Point* l, *on the right Line* ab.

PRACTICE. On the given Point *l*, with any Opening of your Compasses greater than the nearest Distance of the given Point from the Line *ab*, describe an Arch *cd*, cutting the given Line in *cd*; on which, as two Centers with any Distance greater than *ck*, describe Arches below the given Line; as *ee*, *hh*, interfecting each other in *i*.

LAY a Ruler from the given Point *l* to *i*, and draw the Perpendicular required. *Which will bisect* cd *in* k.

DEMONSTRATION.

1. DRAW the Lines *lc*, and *ld*; which, being drawn from *l*, the Center of the Arch *cd*, are therefore equal.

2. THE right Line *cd*, being bisected by the Perpendicular, therefore *ck* and and *kd* are equal: And as the Perpendicular *lk* is common to the Triangles *lck*, and *lkd*, therefore the Angles *lkc*, and *lkd*, are equal, and the Line *lk* perpendicular to *cd*. *Which was to be proved.*

PROBLEM XIV. Fig. XXIII.

To let fall a Perpendicular from a given Point, that is situated nearly over the End of a given right Line, as xb *from the Point* h, *on the right Line* ab.

PRACTICE. 1. Lay a Ruler from the given Point *h*, unto any Part of the right Line, as unto *g*; and draw a right Line, as *gh*.

2. BISECT *gh* in *f*, and on *f*, with the Radius *fg*, describe the Semicircle *hbg*, interfecting the given Line in *b*.

3. DRAW *hb*, and it will be the Perpendicular required.

PROBLEM

PROBLEM XV. Fig. XXIV.

To let fall a Perpendicular, from a given Point, upon a concave circular Line; as ah *on the concave Line* ci.

PRACTICE. 1. Aſſume three Points in any Part of the curve Line, as at *c*, *e*, *g*, and draw the right Lines *ce* and *eg*; which biſect in *d* and *f*, by the Lines *dk* and *fm*, and continue them until they meet in *b*. *Which is the Center of the Curve* ci.

2. LAY a Ruler from *b* unto the given Point *a*, and draw *ab*; which is the Perpendicular required.

PROBLEM XVI. Fig. XXV.

To let fall a perpendicular Line, from a given Point, upon a convex circular Line, as hd, on, ik.

PRACTICE. 1. Open you Compaſſes to any Diſtance greater than the Diſtance of the given Point from the Curve, and deſcribe an Arch, as *ff*, interſecting the given Curve in two Places, as at *e*, *g*, on which Points, with any Diſtance greater than half *eg*, deſcribe Arches, as *aa*, *cc*, interſecting each other in *b*.

2. LAY a Ruler from *b* to the given Point *h*, and draw *hd*, the Perpendicular required.

PROBLEM XVII. Fig. XXVI.

To make an Angle, equal to an Angle given, in any Point of a given right Line.

AT the Point *k* in the right Line *cn*, make the Angle *lkn*, equal to the given Angle *rpq*.

PRACTICE. On the Points *pk*, with any Opening of your Compaſſes, deſcribe equal Arches at Pleaſure, as *no* and *tr*; then take the Diſtance *ts* between your Compaſſes, and ſet it on the Arch *no*, from *n* to *m*; and from the given Point *k*, through *m*, draw the right Line *kl*; then will the Angle *lkn* be equal to the Angle *rpq*.

DEMONSTRATION.

DRAW the Lines *ro*, and *mn*, and the Triangles *spt* and *mkn* will have the Sides *ps*, *pt*, equal to the Sides *km*, *kn*; becauſe the Arches *nm* and *st*, were deſcribed with the ſame Opening of the Compaſſes; and their Baſſes *st* and *mn* being alſo equal; therefore the Angle *lkn* is equal to the given Angle *rpq*; which was to be proved.

S

PROBLEM XVIII. Fig. XXVII.

To make an Angle, even to a ſolid Angle given, in any Point of a given right Line, as wvx, *equal to* bac.

1. BECAUSE that the given Angle is ſolid, and therefore cannot deſcribe an Arch therein, as in the foregoing Problem; therefore continue out the Sides thereof, as the Side *ba*, towards *f*, and the Side *ca*, towards *i*.

2. WITH any Opening of the Compaſſes on the Points *a* and *v* deſcribe the Arches *hg* and *zz*, making *yz* equal to *hg*; then through the Point *y* draw the right Line *vw*, and ſo will the Angle *wvx* be equal to the ſolid Angle *bac*; becauſe that the oppoſite Angle *iaf* is equal to the given Angle *bac*.

THIS Problem is very uſeful in taking ſolid Angles of Buildings, as will hereafter appear, when I come to ſhew you how to take the Plans of Buildings, *&c.*

P. *But ſuppoſe that a ſolid Angle be ſo ſituated by a River-ſide, as* bac, *by the River* AB, *which prevents my continuing on the Side* ba, *towards* f: *Pray how muſt I proceed at ſuch Times to find the Quantity of an Angle?*

M. As following: Continue on the Side *ca* towards *h*, and then will you have formed the Angle *bah*, whoſe Complement to a Semicircle, or 180 Degrees, is (by Def. XVI. Page 117.) the Quantity of the Angle required; for the Angle *bac*, added to the Angle *bah*, being taken together, are a Semicircle.

P. *Very well, Sir; I underſtand you: But ſuppoſe that I have an Angle to take, as the Angle* bah, *that has a Chimney ſtanding in the Angle, as at the pricked Line* 2. 13. 14. 3. *which prevents my meaſuring into the Angle at* a; *Pray how muſt I proceed to know the Quantity?*

M. AS follows: (1.) Aſſume two Points in each Side of the Angle in any Parts thereof, as at the Points 3 and *i*, in the Side *ah*, and the Points 1 and 2, in the Side *ba*; from all which raiſe Perpendiculars, continu'd at pleaſure, as 1-9, 2-10, 3-11, *i* 12. (2.) Set off on each Perpendicular any Length from the Sides of the Angle, as the Diſtance *i* 5, 3-4, 2-7, 1-8; and through the Points 4, 5, 8, 7, draw the right Lines 15-7, and 11-12, which form the ſame Angle as the Lines *ba* and *ah*. (3.) Whoſe Quantity may be found, as before taught.

PROBLEM XIX. Fig. XXVIII.

To draw a right Line parallel to another right Line, at any aſſigned Diſtance, as c *parallel to* nf, *at the Diſtance of* ab.

P. PRAY what are parallel Lines? I don't know that I ever heard of them before.

M. *Parallel Lines are right Lines equidiſtant in every Place, and therefore are ſuch, that being in the ſame Superficies, if infinitely produced, would never meet, as the right Lines* c *and* nf, *which are delineated as following:*

PRACTICE.

Practice. Take the assigned Distance *ab* in your Compasses, and towards each End of the given Line *nf*, assign two Points, as *m* and *h*, on which, as two Centers, describe Arches, as *ee* and *gg*.

2. Lay a Ruler unto their Convexities, until you can but just discern them; and then draw the right Line *cd*, which will be parallel to *nf*, at the assigned Distance *ab*, as required.

PROBLEM XX. Fig. XXIX.

To draw a right Line parallel to another right Line that shall pass through a given Point, as the Line o o, *parallel to* p p, *passing through the given Point* s.

Practice. 1. From the given Point *s* draw a right Line at Pleasure unto any Part of the given Line *pp*, as unto *r*.

2. Take the Length of the Line *sr* in your Compasses, and, on the Points *sr* describe Arches, as *sq* and *tr*, and make *rt* equal to *sq*.

3. Lay a Ruler from *s* to *t*, and draw the Line *oo*, which will be parallel to *pp*, and pass through the given Point *s*, as required.

DEMONSTRATION.

Because that the Angle *srq* is equal to the Angle *tsr*; therefore the Lines *oo*, *pp*, are parallel.

☞ *Note, That the Angles* s r g *and* t s r, *are called Alternate Angles.*

PROBLEM XXI. Fig. XXX.

At a Point given, to make a right Line equal to a right Line given; as at the given Point c, *to make the right Line* c d, *equal to to the given right Line* a b.

Practice. 1. Draw a right Line from the given Point *c*, to one End of the given Line, as to *b*; and on the Line *cb*, erect the equilateral Triangle *ceb*.

2. On the Point *b*, with the Radius *ab*, describe the Circle *afb*, and continue *eb* to *f*, and *ec* at pleasure.

3. On the Point *e*, with the Radius *ef*, describe the Arch *fg*, interfecting the Line *ec* continued in *d*; then will *cd* be a right Line equal to *ab*, as required.

DEMONSTRATION.

ed and *ef* are equal, and *eb* and *ec* are equal; wherefore *cd*, *bf*, and *ab*, are equal. *Which was to be done.*

PROBLEM XXII. Fig. XXXI.

To divide a right Line into any Number of equal Parts: Suppose a b *into seven Parts.*

Practice. From either End of the given Line, as at *a*, draw a right Line as *ac*, making any Angle at pleasure; also from the other End of the given Line

Line *b*, draw the right Line *bd* parallel to *ac*, and continue it out at pleasure. Then opening your Compasses to any small Distance, set off on each Line, from the Ends of the given Line, the same Number of Distances, less one, as the Number of Parts, into which the Line is to be divided, which is 6, because that 7, less 1, is 6, as at the Points 1, 2, 3, 4, 5, 6.

2. LAYING a Ruler from 6, 5, 4, 3, 2, 1, in the Line *ac*, unto 1, 2, 3, 4, 5, in the Line *bd*, it will divide the given Line *ab* into seven equal Parts, as required.

☞ *I shall refer the Demonstration hereof, unto my Lecture on* Geometrical Theorems, *when 'twill be better understood than at present.*

PROBLEM XXIII. Fig. XXXII.

To divide a right Line into any Number of equal Parts, after a different Manner from the preceding.

Let *hi* be a given Line, to be divided into nine equal Parts.

PRACTICE. First, Draw a right Line at pleasure, as *bk*, and thereon set off nine small Divisions, as 1, 2, 3, 4, 5, 6, 7, 8, 9.

Secondly, On *b* 9, erect an equilateral Triangle *ab*9, and continue out the Sides *ab*, *a*9, infinitely.

Thirdly, Make *ad*, and *ae*, each equal to the given Line *hi*, and draw *de*.

Lastly, Lay a Ruler from *a* to the eight Points 1, 2, 3, 4, 5, 6, 7, 8, and draw Lines, which will divide *de* at *aa*, *&c.* into nine equal Parts, as required.

PROBLEM XXIV. Fig. XXXIII.

To divide a right Line into any Number of unequal Parts, in the same Proportion as another Line is already divided.

Let *rs* be a given Line, to be divided in such Proportion as the Line *pq*.

PRACTICE. 1. Draw *bc* equal to *pq*, and thereon erect an equilateral Triangle *hbc*, and continue out the Sides *hb* and *hc* infinitely.

2. MAKE *hd* and *he* each equal to the given Line *rs*, and draw the Line *de*.

3. SET on the Line *cb*, the several Divisions of the Line *pq*, as at *aa*, *&c.* and laying a Ruler from *h* to the several Divisions *aa*, *&c.* in the divided Line *bc*, draw Lines as *ai*, *ak*, *al*, *am*, *an*, *ao*, which will divide the right Line *de* in the same Proportion of *pq*, as required.

PROBLEM

PROBLEM. XXV. Fig. XXXIV.

To complete a Circle, whereof we have but a Part:

Or,

To describe a Circle, whose Circumference shall pass through three given Points, provided they are not placed in a right Line.

Let *a b c* be the given Part of a Circle.

PRACTICE. 1. In the given Arch, assume three Points, as *a*, *b*, *c*, and on either of them, as on *a*, with any Opening of the Compasses greater than half the Distance contained between *a* and *b*, describe an Arch, as *gg*; also, with the same Opening on *b*, intersect the said Arch in *l* and *k* by the Arch *ii*.

2. ON *b*, with any Opening of your Compasses greater than half *b c*, describe an Arch, as *d i*; and on *c*, with the same Opening, intersect the said Arch in *h* and *f* by the Arch *c e*.

3. DRAW the Lines *l o*, and *f h*, continuing them until they meet in the Point *m*, which is the Center of the given Arch, on which you may complete the Circle as required.

DEMONSTRATION.

DRAW the Lines *ab* and *bc*, and they will be divided equally; and the Lines *l o*, and *f h*, will be perpendicular thereto.

PROBLEM XXVI. Fig. XXXV.

To find the Center of a Circle.

'TIS required to find the Center *c* of the Circle *a b g e*.

PRACTICE. 1. Draw a Line a-cross the given Circle in any Part thereof, as *b e*, so that it it intersect the Circumference on each Side, as at *b* and *e*; which bisect in *f*, and thereon raise the Perpendicular *f a*, and continue it t[illegible]

2. BISECT *a g* in *c*; which is the Center required.

DEMONSTRATION.

IF the Point *c* is denied to be the Center, let any other Point be said to be it; suppose the Point *d*: Then I say, if *d* is the Center, the Lines *db* and *de*, must be equal, and the Triangle *d b f* must be equal to the Triangle *d f e*, and consequently *d f* must be perpendicular to *b e*, and not *f a*, which would be contrary to the Hypothesis: Therefore 'tis evident, that the Center cannot be out of the Line *af*. Farthermore, since that the Point *c* divides the Line *a g* into two equal Parts, and *c b*, *c a*, *c e*, *c g*, being equal, therefore *c*

is the Center; otherwise those Lines cb, ca, ce, cg, drawn from it to the Circumference, would not be equal. *Which was to be proved.*

Hence 'tis plain, that the Center of a Circle is in a Line which divideth another Line in the Middle, and that at Right Angles: So c *is in the Line* a f, *which divides* b e *in the Middle at* f *at Right Angles, because that* af *is perpendicular to* b e.

PROBLEM XXVII. Fig. XXXVI.

To divide an Arch Line into two equal Parts, as the Arch e d x.

PRACTICE. Draw a right Line from one Extreme of the Arch unto the other, as ex, which bisect in g, and thereon raise the Perpendicular gz, and continue it to the Arch at d; then will ed be equal to dx, as required.

DEMONSTRATION.

THE Center h is in the Line dz and gz, being perpendicular to ex; therefore ex cuts gz at Right Angles, and eh must be equal to hx; also ed must be equal to dx; otherwise the Lines dz and ex cannot cut each other at Right Angles; wherefore the Arch ed is equal to the Arch dx. *Which was to be proved.*

PROBLEM XXVIII. Fig. XXXVII.

To divide the Circumference of a Circle into thirty-two equal Parts; or otherwise, *To describe the thirty-two Points of the Compass.*

LET AaeB be a given Circle, to have its Circumference divided as aforesaid.

PRACTICE. (1.) Through the Center D draw a right Line, as Ae; also draw aB at Right Angles thereto, and then will the Circumference be divided into four equal Parts, at the Points A, a, e, B, which may represent the four Cardinal Points of the Horizon, *viz.* North, East, South, and West, as therein placed.

(2.) BY the last Problem, divide the Arch ae into two equal Parts by the Line ic, drawn from c, the Intersection of the Arches aa and be, unto the Center D. In the same Manner divide the other three Arches eB, BA, and Aa; and then will those four Divisions represent the North-East, South-East, South-West, and North-West Points, and the Circle will then be divided into eight equal Parts.

(3.) DIVIDE the Arches ai and ie in like manner, by the Arches $a6$, $4i$; and ir, se; and from 5 and q, the two Points of Intersection, unto the Center D, draw the two right Lines $5g$ and lq, then will the Quadrant or Arch ae, be divided into four equal Parts at the Points g, i, l.

(4.) IN the same Manner divide the Arches ag in f, gi in h, il in k, and le in m; and then will the Arch or Quadrant ae, be divided into eight equal Parts.

(5.) COMPLETE the other three Quadrants in like manner, and the Circumference of the Circle AaeB, will be divided into 32 Parts, as required.

PROBLEM

PROBLEM XXIX. Fig. XXXVIII.

A right Line being given, to find a Point in a direct Position thereto; for the Continuation thereof,

LET *bd* be the given Line, and 'tis required to find a Point in a direct Position thereto, that the said Line being continued, shall pass through the same.

PRACTICE. (1.) On the End *d*, with any Opening of your Compasses, describe an Arch as *aa*, intersecting the given Line in *i*.

(2.) SET off any Distance from *i* to *c*, and the same from *i* to *b*; on which, as two Centers, with any Opening greater than *bd*, describe Arches, as *ee* and *ff*, intersecting each other in *g*, which is the Point required, through which the right Line *bd* will pass, being continued.

PROBLEM XXX. Fig. XXXIX.

Two Points being given, to find two other Points directly interposed. Or to draw a right Line between two given Points with a Ruler, whose Length is equal but to Half the given Distance contain'd between them.

Let A and B be the given Points.

PRACTICE. (1.) Upon the Points AB, as Centers, with any Opening of Compasses greater than Half the Distance of AB, describe Arches, as *dd* and *cc*, intersecting in *ef*.

(2.) UPON the Points *ef*, as Centers, with any Opening greater than Half *ef*, describe Arches, as *gh*, and *hg* intersecting in the Points *nm*, which are directly interposed between the given Points A and B; by Help of which, with your short Ruler, draw the right Line AB, as required.

PROBLEM XXXI. Fig. XL.

To describe a Segment of a Circle, in which any Angle being drawn from the Extremes of the Chord Line, shall be each equal to an Angle given.

Let BC be the given Chord Line, and A the given Angle.

PRACTICE. (1.) Make the Angle *c*B*b* equal to the Angle A, and on B erect the Perpendicular B*f*, continuing it out at pleasure.

(2.) BISECT BC in *e*, and thereon raise the Perpendicular *ed*, until it meet B*f* in *d*, on which, as a Center, describe the Arch B*n*C; then will every Angle form'd in the Arch B*gnf*C, whose Sides pass through the Ends of the Chord Line BC, be equal to the given Angle A.

So the Angles B*g*C, B*n*C, and B*f*C, are each equal to the given Angle A.

DEMONSTRATION.

j

DEMONSTRATION.

THE Angles *dCB*, and *CBd*, being equal, the Lines *dC* and *dB* are equal; becauſe *d* is the Center, on which their Ends BC are terminated by the Arch. Now the Angle *hBf* being right, the Line *hB* toucheth the Circle in the Point B; therefore the Angle, which the Segment B*gnf*C comprehendeth, as the Angle B*f*C is equal to the Angle *h*BC, or to the given Angle A.

THE well underſtanding of this Problem will be of admirable Uſe to all Workmen that work by a Square; for thereby they may moſt readily make, or prove them.

P. *Pray how can that be? I don't ſee that in this Scheme or Diagram there be one Square or Right Angle, more than thoſe made by the Line* de *on the given Chord Line* BC, *which I believe is of ſmall Uſe for that Purpoſe, more than what has been already delivered: Therefore pray explain it to me?*

M. I WILL: Through the Center *d* draw a Diameter, as *ko*, and let *ki* be drawn at Right Angles to *ko*, as ſuppoſing the given Angle to be a Right Angle; then I ſay, for the ſame Reaſon, as the Angles B*g*C, B*n*C, and D*f*C, were each equal to the Angle CB*h*; ſo will every Angle form'd on the Extremes of the Diameter *ko*, in the Semicircle *klo*, be a right Angle alſo; as *klo*, *kmo*, or any other two Lines whatſoever. Therefore to prove if a Square be truly made, deſcribe a Semicircle, and therein apply the Square, and if the two Sides thereof paſs by the Ends of the Diameter, and the angular Point of the Square touch the Circumference of the Circle in any Part at the ſame Time, the Square is truly made; otherwiſe 'tis falſe.

PROBLEM XXXII. Fig. XLI.

A Circle being given to cut off a Segment that ſhall contain an Angle given;

Let *bade* be the given Circle, and *h* the given Angle.

PRACTICE. (1.) Draw the Semidiameter *ce* and *eg* at right Angles thereto.

(2.) MAKE the Angle *gef* equal to the given Angle *h*, and continue *ef* to *d*.

(3.) ALL the Angles made upon *ed*, in the Segment *ebad*, will be each equal to the given Angle *h*, as required.

PROBLEM XXXIII. Fig. XLII.

From a given Point, to draw a Chord Line in a given Circle that ſhall be equal to a given Line;

Let D be the given Point, AB the given Line, and *glf* the given Circle.

PRACTICE. (1.) Take the given Line AB in your Compaſſes, and ſet on any Part of the Circumference, as from *f* to *g*, and draw the Line *fk* infinitely through the Points *gf*.

(2.) FROM

Rob.t Watson written November the 26 - 1799

(2.) FROM the given Point D, draw the Line D*e*; and on the Center *e*, with the Radius *e*D, deſcribe the Arch D*i*, cutting *fk* in *h*.

(3.) TAKE *hf* in your Compaſſes, and ſetting one Foot in the given Point D, with the other interſect the Circle in *n* by the Arch *mm*, and draw the Line D*n*; then will the Chord Line *ln*, be equal to the given Line AB, as required.

PROBLEM XXXIV. Fig. XLIII.

To cut off from a Line any Part required.

It is required, to cut off two ninth Parts of the Line *xy*.

PRACTICE. (1.) Draw two right Lines, making any Angle at Pleaſure, as *ae*, *ag*, and in either of thoſe Lines ſet off nine ſmall equal Diviſions, as at 1, 2, 3, 4, 5, 6, 7, 8, 9, and let *ad* be equal to ſeven of the ſame, and *ac* be equal to *xy*.

(2.) DRAW the Line c*e*, and *db* parallel thereto; then will *ab* be equal to ſeven Ninths of *ac*, or *xy*.

DEMONSTRATION.

IN the Triangle *cae*, *bd* being parallel to *ce*, there will be the ſame Reaſon of *ad* to *de*, as of *ab* to *bc*; and as *ad* contains ſeven Ninths of *ae*, therefore *ab* ſhall contain ſeven Ninths of *ac*, or *xy*. *Which was to be proved.*

LECTURE III. By Z—Z— Plate IV.

On the Generation of Regular GEOMETRICAL FIGURES.

M. THE next Part of Geometry, with which you are to be acquainted, is the Generation of regular ſuperficial Figures, wherein you will be agreeably entertain'd, and enabled to paſs through the Conſtructions thereof in the next Lecture with equal Pleaſure. The Figures to be here conſidered, are the various Kinds of Triangles, the Square, the Parallelogram, the Rhombus, the Rhomboides, and the Polygons.

P. *Are there not other regular Geometrical Figures?*

M. YES: There are alſo the Ellipſis, Parabola, and Hyperbola. But I ſhall explain them hereafter, in my Lecture upon Conick Sections.

P. *How is an equilateral Triangle generated?*

M. BY three equal right Lines, having their Ends applied to each other, whereby they will conſtitute or generate an equilateral Triangle. And ſo in like manner, if three unequal Lines, of which any two, being taken together, are greater than the third, have their Ends applied together, they ſhall generate a Scalenum Triangle. And alſo, if of three Lines there be two equal, and the third unequal, they will generate an Iſoſeles Triangle.

P. *I understand you perfectly well; Pray proceed to the Square.*

M. I WILL. The Geometrical Square is generated as follows:

LET the Lines *ab*, *ag*, Fig. XLIV. form a right Angle, and *ac* be equal to *ab*; then if the Line *ab* be removed forward unto *c*, so as for its End *a* to be always on the Line *ag*, and all its Parts move equally at the same time, it will, by its Motion, have passed through a superficial Space equal to *abid*; and since that *ac* is equal to *ab*, and all the Parts of the Line *ab* moved equally in the same time, therefore *ab*, in the Place of *cd*, will remain perpendicular to *ag*, as at first; and the Superficies described by its Motion, will be a geometrical Square.

NOW from hence you see, that as a Line is generated by the Motion of a Point, on a plain Surface or Superficies; so in like manner this square Superficies is generated by the Motion of a Line.

THE Parallelogram *abgh*, is also generated in the same manner; for if the Line *ab*, after 'tis moved to *cd*, pass on with equal Motion in all its Parts further to *ef*, and thence to *gh*, it will then have passed through a Space, whose Length is *ag*, and Breadth *ab*, and generate the Oblong, or Parallelogram *abgh*.

THE Rhombus, *Fig.* XLV. is also generated in the same manner; for if the Line *ab*, making an Angle of 45 Degrees with the Line *bf*, move towards *f*, with equal Motion in all its Parts, and the End *b* always in the Line *bf*, it will generate the Rhombus *adbc*, when the Point *b*, be arrived at *c*; supposing *bc* equal to *ab*: And if *ab*, when moved to *dc*, move on to *ef*, it will describe the Rhomboides *a*, *e*, *b*, *f*.

As three equal right Lines, having their Ends applied together, generate an equilateral Triangle, so six equilateral Triangles, having their Sides applied regularly together, generate a Hexagon; that is, if the equilateral Triangles *a*, *b*, *c*, *d*, *e*, *f*, Fig. XLVI. be applied together, as *g*, *h*, *i*, *k*, *l*, *m*, they will complete the Hexagon *n*, *o*, *p*, *q*, *r*, *s*.

THE other Polygons, namely, the Pentagon, Septagon, Octagon, Nonagon, Decagon, &c. are generated by the Applications of Five, Seven, Eight, Nine, Ten, &c. Isosceles Triangles, as in *Fig.* XLVII. having their Sides proportioned, as will be hereafter taught.

THESE being severally well understood, will render the following Lecture very easy.

LECTURE

LECTURE IV. By X——X— Plate IV.

On the Geometrical Construction of Superficial FIGURES.

PROBLEM I. Fig. XLVIII.

To describe an Isosceles Triangle, that shall have two Sides each equal to the given Line aa, *and the third Side equal to the given Line* bb.

PRACTICE. Make *fg* equal to *bb*; and with the Length of *aa* in your Compasses, on *f* describe the Arch *cc*; and with the same Opening on *g*, the Arch *dd*, intersecting *cc* in *e*. Draw the right Lines *ef*, *eg*, and they complete the Isosceles Triangle required.

PROBLEM II. Fig. XLIX.

To describe a Scalenum Triangle, whose three Sides shall be equal to three given Lines, of which any two taken together be greater than the third, as aa, bb, cc.

PRACTICE. Make *gh* equal to *aa*, and on *g*, with the Length of *bb*, describe the Arch *ff*; and on *h*, with the Length *cc*, describe the Arch *ee*, intersecting *ff* in *d*. Draw the right Lines *dg*, *dh*, and they complete the Scalenum Triangle required.

PROBLEM III. Fig. L.

To describe a Geometrical Square, whose Sides shall be respectively equal to a given Line, as aa.

PRACTICE. *First*, Make *fg* equal to *aa*, and on *g* raise the Perpendicular *ge*, which make equal to *aa*. *Secondly*, With the Length *aa*, on *e* describe the Arch *bb*, and on *f*, with the same Opening, describe the Arch *cc*, intersecting *bb* in *d*. Draw the right Lines *de*, *df*, and they complete the Geometrical Square *defg*, whose Sides are severally equal to the given Line *aa*, as required.

PROBLEM IV. Fig. LI.

To describe a Parallelogram, whose Length shall be equal to aa, *and Breadth to* bb.

PRACTICE. *First*, Make *gh* equal to *aa*, and on *h* raise the Perpendicular *hf*; which make equal to *bb*. *Secondly*, On *g*, with the Length *bb*, describe the Arch *dd*; and on *f*, with the Length *aa*, describe the Arch *cc*, intersecting *dd* in *e*. *Thirdly*, Draw the right Lines *ef*, *eg*, and they complete the Parallelogram required.

PROBLEM V. Fig. LII.

To describe a Rhombus, whose Sides shall be severally equal to a given Line aa.

PRACTICE. Make *bf* equal to *aa*, and on *f*, with the Length *bf*, describe the Arch *bcde*, and set *bf* from *b* to *c*, and from thence to *d*. *Lastly*, Draw the right Lines *bc*, *cd*, and *df*, and they will complete the Rhombus required.

PROBLEM

PROBLEM VI. Fig. LIII.

To describe a Rhomboides, whose longest Sides shall be each equal to the given Line aa, *the shortest to* bb; *and acute Angles each equal to the given Angle* B.

PRACTICE. *First*, Make *kg* equal to *aa*, and at *k* make an Angle equal to the given Angle B, and make *kh* equal to *bb*. *Secondly*, On *g*, with the Length *kh*, describe the Arch *ff*; and on *h*, with the Length *kg*, describe the Arch *ee*, intersecting *ff* in *i*. *Thirdly*, Draw the right Lines *hi*, *ig*, and they complete the Rhomboides required.

PROBLEM VII. Fig. LIV.

To describe a Trapezium, whose four Sides shall be equal to four given Lines, (*as* aa, bb, cc, dd,) *with the Angle made by the Sides* aa *and* cc, *equal to an Angle given, as the Angle* e.

PRACTICE. *First*, Make *fl* equal to the greatest Line *dd*; and at *f* make an Angle equal to the given Angle *e*, also make *fg* equal to *cc*. *Secondly* On *g*, with the Length *bb*, describe the Arch *kk*; and on *l*, with the Length *aa*, describe the Arch *hh*, intersecting *kk* in *i*. *Thirdly*, Draw the right Lines *gi*, and *il*, and they will complete the Traperzium required.

PROBLEM VIII. Fig. LV.

To make a Geometrical Square, having the Difference between its Side and the Diagonal given.

Let *an* be the Difference given.

PRACTICE. *First*, On *n* erect the Perpendicular *nm*, which make equal to *an*; and by the Points *a*, *m*, draw the Line *ax* of any Length. *Secondly*, Upon the Point *m*, with the Radius *mn*, describe the Arch *nx*, cutting the Line *ax* in *x*; then will *ax* be the Side of the Square required. *Thirdly*, On *x*, erect the Perpendicular *xo* equal to *ax*, and draw *ano*, which is a Diagonal; of which, *no* is equal to the Side *xo*, or *ax*; and *an*, the Remainer, is the Difference that was given. *Fourthly*, Bisect *ao* in *z*, and on *z*, as a Center, with the Radius *xz*, describe the Circle, and complete the Square *axor* therein, as required.

PROBLEM IX. Fig. LVI.

To describe an Oval of any assign'd Length.

Let the given Length be *ax*.

PRACTICE. *First*, Divide the Length *ax* into three equal Parts, at *e* and *f*; upon which, as two Centers, with the Radius *ae*, describe the Circles *abcfng*, and *ecdxhn*, intersecting each other in *c* and *n*. *Secondly*, From the Points *c* and *n*, through the Points *e* and *f*, draw the Lines *nfd*, *neb*, *cfh*, *ceg*; then on the Centers *cn*, with the Radius *nb*, describe the Arches *bd* and *gh*, which will complete the Oval required.

Note,

Note, *This, and all other ſuch like Figure, that is compounded of Arches or Circles, I call an Oval, not an Ellipſis, as 'tis by many; therefore obſerve, that when I ſpeak of an Ellipſis, I ſhall mean a Figure generated by the oblique Section of a Cylinder, or Cone, whoſe Curve has no Part of a Circle contained in it, as will be hereafter demonſtrated in its Place.*

PROBLEM X. Fig. LVII.

To deſcribe an Oval of any given Length, without Reſpect being had to its Breadth, after a different Manner from the foregoing.

Let *lk* be the given Length.

PRACTICE. *Firſt*, Divide the Length *lk* into four equal Parts at *a*, *b*, *c*; whereon, as ſo many Centers, with the Radius *la*, deſcribe the Circles *lhbi*, *adce*, *bfkg*. *Secondly*, Draw *de* through *b*, at right Angles to *lk*, and from the Points *d* and *e*, through the Points *a* and *c*, draw the right Lines *ecf*, *eah*, *dcg*, *dai*, terminating in the Points *h*, *f*, *i*, *g*. *Thirdly*, On the Points *d* and *e*, with the Radius *eh*, deſcribe the Arches *hf* and *ig*; which will complete the Oval as required.

PROBLEM XI. Fig. LVIII.

An Oval being given, to find its Center and two Diameters;

Let *aneh* be the given Oval.

PRACTICE. *Firſt*, Draw at pleaſure two parallel Lines in any Part of the Oval, as *qf* and *bn*, biſect them in the Points *mo*, through which draw the Line *id*; biſect *id* in *p*, which is the Center of the Oval. On *p* with any Opening greater than *pn*, and leſſer than *pe*, deſcribe a Circle, cutting the Circumference of the Oval in *c* and *g*. Biſect *cg* in *k*, and through the Points *k*, *p*, draw the longeſt Diameter *akpe*. *Laſtly*, Through *p* draw *nh* at right Angles to *ae*, which will be the ſhorteſt Diameter; and thus will you have diſcovered the Center *p*, and two Diameters *ae* and *nh*, as required.

PROBLEM XII. Fig. LIX. Plate V.

To deſcribe an Oval of any Length and Breadth required.

Let *aa* be the given Length, and *bb* the given Breadth.

PRACTICE. *Firſt*, Make *cd* equal to *aa*, which biſect in *g* by the Perpendicular *ef*, making *ge* and *gf* each equal to half *bb*; then will *cd* be the longeſt, and *ef* the ſhorteſt Diameter. *Secondly*, Set *eg*, half the ſhorteſt Diameter, from *g* to 3 on the longeſt Diameter, which divide into three equal Parts. *Thirdly*, Set one of thoſe three Parts from 3 to *h*, and make *gi* equal to *gh*; and on *hi*, erect the two equilateral Triangles *hki* and *hil*, continuing out their Sides *kh*, *ki*, *lh*, *li*, at pleaſure, as to *q*, *r*, *s*, *t*. *Fourthly*, On the Points *h*, *i*, with the Radius *ch*, deſcribe the Arches *mcn* and *odp*; alſo on the Points *k*, *l*, with the Radius *ln* or *lo*, deſcribe the Arches *neo* and *mfp*; which will complete the Oval required, whoſe Length and Breadth will be equal to the given Lines *aa* and *bb*, as required.

☞ NOTE,

NOTE, Since that Ovals are composed by Arches of Circles, therefore you may on the same Centers describe other Ovals concentrick to the first, as the Oval *vxwz*, which is described on the Centers *h, i, k, l*, at the Distance of *fy*; and so in like manner any other.

P. *But, Sir, suppose I am to describe an Oval in a Place that is not broader than the given Breadth of the Oval, and consequently cannot have an Opportunity of finding the Centers* k, l, *which lie without the given Limits; Pray how must I describe such an Oval?*

M. As following: By three Methods.

METHOD I. Fig. LX.

Let the given Length be the right Line a, *and given Breadth the right Line* b.

PRACTICE. *First*, Make *cn* equal to the right Line *a*, and bisect it in *g*, and draw *ef* at right Angles thereto, and equal to the given Breadth *b*. *Secondly*, Take Half the longest Diameter *gn* in your Compasses, and on *f* intersect *cn* in *dh*; which Points are called the *Focus Points* of the Oval or Ellipsis. In which fix two Pins, Nails, or Stakes, if the Ellipsis be large, and to them fit a Line, that when extended at its Bending, shall exactly reach to the End of the longest Diameter at *c* or *n*; which Line so fixed, shall, with a Black-Lead Pencil, &c. applied perpendicularly thereto, trace or describe the Oval, or Ellipsis, as required.

NOTE, *That the Diameters of an Oval, or Ellipsis, are distinguished from each other by the Names of Conjugate and Transverse, that is, the longest is called the Conjugate, and the shortest the Transverse Diameter.*

METHOD II. Fig. LX.

Let the given Length and Breadth be the same, and draw the two Diameters at right Angles as before.

PRACTICE. Make a Ruler as *pq*, whose Length must be equal to the greater Semidiameter *cg* or *gn*; upon which set off the lesser Semidiameter *eg*, or *gf*, from *p* to *m*. This done, apply your Ruler in such a Manner upon the Diameters *cn* and *ef*, that the Point *m* passing along the Diameter *cn*, the End *q* may always be in the Diameter *ef*; then moving the End *p* to *e*, thence to *c*, thence to *f*, thence to *n*, and thence to *p*, the Point from whence you moved first, the End *p* will have described the true Curvature of the Ellipsis, as required.

METHOD III. Fig. LXI.

Let the right Lines f, g, *be the given Diameters.*

PRACTICE. *First*, Make a Parallelogram, as *aced*, whose Length *cb* shall be equal to *f*, and Breadth *ed* equal to *g*, and bisect the Sides and Ends thereof in the Points *x, h, n, m*. *Secondly*, Divide *xc* and *cn*, each into any Number of equal Parts, as 6, 8, 10, 12, 14, 16, &c. the more the better. In this Example, I have divided each into eight equal Parts, as *xc* at the Points 1, 2, 3, 4, 5, 6, 7; and *cn* at the Points 7, 6, 5, 4, 3, 2, 1. *Thirdly*, Draw the right Lines *x*7; 1,6; 2,5; 3,4; 4,3; 5,2; 6,1; 7*n*. Which Lines will

will form one quarter Part of the Oval. *Laſtly*, The other three Parts being formed in the like Manner, will complete the Oval, as required.

P. *This is a very eaſy and delightful Method, being perform'd without any Regard to its Center, or Focus Points, as in the foregoing; and I imagine muſt be of very great Uſe at ſome Times, when an Elliptical or Ovallar Wall may be required to be built, to incloſing a Wood,* &c. *where there's no Poſſibility of making uſe of Lines,* &c. *as in the preceding Methods.*

M. 'TIS true; you obſerve very juſtly: In ſuch Caſes, 'tis the only Way yet made publick.

P. *Pray, Sir, is it an Invention of your own?*

M. NO: It was firſt invented by Mr. *William Halfpeny*, alias *Hoare*, lately of *Richmond* in *Surry*, Carpenter.

P. *Pray is this Method applicable to any other curved Figures?*

M. YES: Circles may be alſo thus deſcribed, as *Fig.* LXV. Which is done by firſt making a geometrical Square, as *abfh*, whoſe Sides ſhall be each equal to the Diameter of the given Circle; and then each being biſected in *dceg*, and divided into any Number of equal Parts, as before in the Parallelogram, and Lines drawn from and to the reſpective Points of Diviſion, they will form the Curvature or Circumference of the Circle, as required.

BUT you are to conſider, that the Formation of the Circle depends upon the Angles of a geometrical Square, being truly right-angled; for were the Angles not to be right-angled, the Figure form'd would be an Oval, and not a Circle, as you may obſerve in *Fig.* LXII. where the Sides of the Rhombus *acfh*. are equal to the Sides of the geometrical Square *abfh*, and are beſected, divided, and Lines drawn, in the very ſame Manner; but the Angles thereof not being right-angled, the Lines do therefore form an Oval, and not a Circle, as before noted.

THE like is to be obſerved in the Rhomboides *acfg*, Fig. LXIII. whoſe Length *ac*, and End *cg*, are equal to *ae* and *ed*, the Length and Breadth of the Parallelogram *aced*, Fig. LXI. For by the Obliquity of the Angles of the Rhomboides, the Length *xx* of the Oval therein deſcribed becomes greater, and Breadth *zz* leſſer than *xm* and *bn* of the Oval, Fig. LXI.

HENCE 'tis plain, that unleſs the Angles of a Parallelogram are truly right-angled, the Oval within it cannot be made equal to the given Length and Breadth, as required.

P. *I ſee it plainly: Pray, Sir, proceed to other Works that are capable of being perform'd by this Method.*

M. I WILL, in ſome few more; and then refer the Remainder unto my Lecture on the Generation of Arches and Groins, wherein it will be more largely handled. What I ſhall here further take notice of for the preſent, is, *Firſt*, The Manner of deſcribing Ovals, that are broader at one End than at the other, as *Fig.* LXVI. commonly called Egg-Ovals. And *Laſtly*, The Manner of deſcribing a regular Curve within an irregular Trapezium; as *bd*, *ef*, within the Trapezium *acgh*, Fig. LXIV.

PROBLEM

PROBLEM XIII. Fig. LXVI.

To describe an Egg-Oval to any assign'd Length.

Let *x x* be the given Length.

PRACTICE. *First*, Divide *x x* into three equal Parts at *z w*, and make the Parallelogram *a c h e*, whose Length shall be equal to *x x*, and Breadth to *x w*. *Secondly*, Make *ab*, *bf*, each equal to *x z*, and bisect *a h* in *g*, and *c e* in *d*; then dividing *ab*, and *bc*, each into the same Number of equal Parts; also *cd*, *de*, *ef*, *fh*, *hg*, and *ga*, in like manner; and from the respective Points of Division, draw right Lines as before taught, you will form the Egg-Oval as required.

PROBLEM XIV. Fig. LXIV.

To inscribe a regular irregular Curve within an irregular Trapezium, as ebdf *within* acgh.

PRACTICE. Bisect *ac* in *b*, *ch* in *d*, *gh* in *f*, and *ag* in *e*; and divide *ab*, *bc*, *cd*, *dh*, *hf*, *fg*, *ge*, and *ea*, each into any and the same Number of equal Parts; and then drawing right Lines from the respective Points, they will form the Curve required.

I SHALL now proceed to shew you, How to determine or find a sufficient Number of Points, through which you may trace the Circumference of any Circle or Curve of any Ellipsis required, without any Regard being had to their Centers, or *Focus Points*, for describing the same.

PROBLEM XV. Fig. LXXIII.

The Diameter of a Circle being given, to find a sufficient Number of Points, through which the Circumference thereof may be traced.

Let the right Line *f h* be the given Diameter.

PRACTICE. *First*, Make *ac* equal to *fh*, and bisect it in *e*. *Secondly*, Draw *bd* through *e*, at right Angles to *ac*, and make *eb*, *ed*, each equal to half *ac*. *Thirdly*, Draw a right Line at Pleasure, as *ac*, Fig. LXVIII. of any Length; which bisect in *d*, and thereon raise the perpendicular Line *db*, which make equal to *dc*, and on *d* describe the Semidiameter *a b c*, whose Circumference you are to divide into 180 Degrees, that is, each Quadrant thereof into 90 Degrees, as has been already taught. In this Example, I shall only divide to every 10 Degrees, as exhibited in the Figure.

THE Circumference being thus divided, draw the chord Lines 10, 10; 20, 20; 30, 30; 40, 40; 50, 50; 60, 60; 70, 70; and 80, 80; which will intersect and divide the Semidiameter *b d* unequally in the Points *x x x*, *&c.*

Fourthly, by Problem XXIV. Lecture II. divide the Semidiameters *ae*, *be*, *ec*, *ed*, each in the same Proportion, as *bd*, Fig. LXVIII. as at the Points *zzz*, *&c.* through which draw right Lines parallel to *ac*, and unto *bd*, that will intersect each other in *nnn*, *&c.* which are the Points through which a Line being traced, will be the Circumference of the Circle required.

N. B. *The Semidiameter of any Circle being so divided, is called a Line of Sines, whose Uses will be largely handled in plain Trigonometry.*

P. *Pray*,

P. *Pray, Sir, can an Oval or Ellipsis be thus traced?*

M. YES: As follows.

PROBLEM XVI. Fig. LXVII.

The conjugate and transverse Diameters of an Ellipsis being given, to find a sufficient Number of Points, through which the Curve thereof will pass.

LET *ab* and *ce* be the Diameters given, intersecting each other at Right Angles in *n*; and let *cn* be equal to *ne*, and *an* equal to *nb*.

PRACTICE. Divide the Semidiameters *cn* and *ne*, also the Semidiameters *an* and *nb*, each in the same Proportion as *bd*, Fig. LXVIII. and through those Divisions draw right Lines parallel to *ce* and *ab*, they will intersect each other in the Points *xxx*, &c. through which a Line being traced, will be the Circumference or Curve of the Ellipsis required.

IN the same Manner, you may describe the curve Line of an Ellipsis within a Rhombus, *ebfh* within *acgi*, as *Fig.* LXIX. where the Semidiameters *ed*, *db*, *df*, *dh*, being divided into such Proportion as *bd*, Fig. LXVIII. and right Lines being drawn through the same, parallel to themselves, (as in the Figure,) the Intersections thereof will produce Points, through which the Curve of the Ellipsis will pass, that will be equal to the Curve of the Ellipsis *dbeg* form'd in the Rhombus *acfh*, Fig. LXII.

NOTE, *Half the Ellipsis,* Fig. LXII. *that is* dbe, *may be considered as a Rampant Arch; as also may* ebf, *in* Fig. LXIX. *But more of this in its proper Place.*

THUS have I largely explain'd to you the various Methods to describe an Oval or Ellipsis: I shall now proceed to the Manner of describing regular Polygons.

PROBLEM XVII. Fig. LXX.

A Circle being given, to find the Side of an Equilateral Triangle, Geometrical Square, Pentagon, Hexagon, Septagon, Octagon, Nonagon, and Decagon, that may be made in its Circumference.

Let *adiz* be the given Circle, and *h* its Center.

PRACTICE. *First*, Draw the Diameter *ai*, and making *ac* and *am* each equal to *ah*, draw *cm*, which is the Side of an equilateral Triangle that may be described therein; therefore on *c*, Fig. LXXI. with the Radius *ab*, describe the Circle *abd*; and then assuming a Point in any Part of its Circumference, as at *d*; from thence set off the Length *cm* to *a*, and from *d* to *b*, and draw the Lines *da*, *db*, they will complete the equilateral Triangle within the Circle, as required. *Secondly*, Draw *dz* through the Center *h* at right Angles to *ai*, and draw *ad*, which is the Side of a geometrical Square; therefore on *e*, Fig. LXII. with the Radius *ah*, describe the Circle *bacd*; and then assuming a Point in any Part of its Circumference, as at *d*, from thence set off the Length *ad* to *b*, thence to *a*, and thence to *c*; and drawing the Lines *db*, *dc*, *ab*, *ac*, they will complete the Geometrical Square, as required. *Thirdly*, On *f*, in the Line *ai*, with the Radius *fd*, describe the Arch *de*; and draw the Line *de*, which is the Side of a Pentagon; therefore on *f*, Fig. LXXIV. with the Radius *ab*,

Oo describe

describe the Arch *abdce*; and then assuming a Point in any Part of its Circumference, as at *e* from thence set off *de* (in Fig. LXX.) to *c*, thence to *a*, thence to *b*, and thence to *d*; and drawing the right Lines *ce*, *ca*, *ab*, *bd*, and *de*, they will complete the Pentagon, as required. *Fourthly*, The Semidiameter *ab*, is the Side of a Hexagon; therefore on *g*, Fig. LXXV. with the Radius *ab*, describe the Circle *abcdef*; and then assuming a Point in any Part of its Circumference, as at *f*, from thence set off *ab* to *e*, thence to *c*, thence to *a*, thence to *b*, and thence to *d*; and then drawing the right Lines *fe*, *ec*, *ca*, *ab*, *df*, they will complete the Hexagon, as required. *Fifthly*, Half *cm*, that is *cf*, is the Side of a Septagon; therefore on *h*, Fig. LXXVI. with the Radius *ab*, describe the Circle *cabedgf*; and then assuming a Point in any Part of its Circumference, as at *g*, from thence set off *cf* to *d*, thence to *c*, thence to *a*, thence to *b*, thence to *e*, and thence to *f*; and then drawing the Lines *gd*, *dc*, *ca*, *ab*, *be*, *ef*, and *fg*, they will complete the Septagon, as required. *Sixthly*, Divide the Arch *abd* into two equal Parts at *b*, and draw *ab*, which is the Side of an Octagon; therefore on *i*, Fig. LXXVII. with the Radius *ab*, describe the Circle *abcdefgh*; and then assuming a Point in any Part of its Circumference, as at *g*, from thence set off *ab* to *h*, thence to *a*, thence to *b*, thence to *c*, thence to *d*, thence to *e*, thence to *f*; and then drawing the right Lines *gh*, *ha*, *ab*, *bc*, *cd*, *de*, *ef*, and *fg*, they will complete the Octagon, as required. *Seventhly*, Divide the Arch *cam* into three equal Parts, then will one third Part thereof, as *xm*, be the Side of a Nonagon; therefore on *k*, Fig. LXXVIII. with the Radius *ab*, describe the Circle *abcdefghi*; and then assuming a Point in any Part of its Circumference, as at *g*, from thence set off *xm* to *h*, thence to *i*, thence to *a*, thence to *b*, thence to *c*, thence to *d*, thence to *e*, thence to *f*, and thence to *g*; and then drawing the right Lines *gh*, *hi*, *ia*, *ab*, *bc*, *cd*, *de*, *ef*, and *fg*, they will complete the Nonagon, as required. *Eighthly*, The Distance *he*, or Half *de*, is the Side of a Decagon; therefore on *l*, Fig. LXXIX. with the Radius *ab*, describe the Circle *abcdefghik*; and then assuming a Point in any Part of its Circumference, as at *i*, from thence set off *he* to *k*, thence to *a*, thence to *b*, thence to *c*, thence to *d*, thence to *e*, thence to *f*, thence to *g*, and thence to *h*; and then drawing the right Lines *ik*, *ka*, *ab*, *bc*, *cd*, *de*, *ef*, *fg*, and *gh*, they will complete the Decagon required.

THUS have I shewn you how to make any Polygon within the Circumference of a given Circle: I shall now proceed to shew you how to make them severally, having a Side only given.

PROBLEM XVIII. Fig. LXXX.

To make a Regular Pentagon, whose Sides shall be each equal to a given Line, as gf.

PRACTICE. *First*, On the Points *g* and *f*, with the Radius *gf*, describe the Arches *ge* and *fd*, intersecting in *n*. *Secondly*, Bisect *gf* in *x*, and draw *xn*. *Thirdly*, Divide the Arch *nf* into two equal Parts at *k*; also divide *nk* into three equal Parts at the Points *h*, *i*; then making *nz* equal to *nh*, *z* will be the Center of the Pentagon. *Fourthly*, On *z*, with the Radius *zf*, describe the Circle *fgabc*, and set *gf* from *g* to *a*, from *a* to *b*, and from *b* to *c*; and then drawing the right Lines *ga*, *ab*, *bc*, and *ef*, they will complete the Pentagon, as required.

PROBLEM

PROBLEM XIX. Fig. LXXXI.

To make a Regular Hexagon, whoſe Sides ſhall be each equal to a given Line, as hg.

PRACTICE. *Firſt*, On the Points *hg*, with the Radius *hg*, deſcribe the Arches *hf* and *eg*, interſecting each other in *n*; which is the Center of the Hexagon. *Secondly*, On *n*, with the Radius *ng*, deſcribe the Circle *abcdhg*, and ſet *hg* from *h* to *a*, from *a* to *b*, from *b* to *c*, from *c* to *d*, and from *d* to *g*; and then drawing the right Lines *ha*, *ab*, *bc*, *cd*, and *dg*, they will complete the Hexagon, as required.

PROBLEM XX. Fig. LXXXII.

To make a Regular Septagon, whoſe Sides ſhall be each equal to a given Line, as y f.

PRACTICE. *Firſt*, On the Points *yf*, with the Radius *yf*, deſcribe the Arches *yh* and *fg*, interſecting each other in *s*, *Secondly*, Biſect *yf* in *z*, and draw *kz* through *s*. *Thirdly*, Divide the Arch *sf* into two equal Parts at *o*; alſo divide *so* into three equal Parts at the Points *nm*, and make *sx* equal to *sn*; then will the Point *x* be the Center of the Septagon, *Fourthly*, On *x*, with the Radius *xf*, deſcribe the Circle *abcdefy*; and ſet *yf* from *y* to *a*, from *a* to *b*, from *b* to *c*, from *c* to *d* and from *d* to *e*; and then drawing the right Lines *ya*, *ab*, *bc*, *cd*, *de*, and *ef*, they will complete the Septagon required.

PROBLEM XXI. Fig. LXXXIII.

To make a Regular Octagon, whoſe Sides ſhall be each equal to a given Line, as p l.

PRACTICE. *Firſt*, On the Points *pl*, with the Radius *pl*, deſcribe the Arches *ph* and *li*, interſecting each other in *z*. *Secondly* Biſect *pl* in *o*, and draw *of* through *z*. *Thirdly*, Divide the Arch *zl* into two equal Parts in *x*; alſo *xz* into three equal Parts at the Points *mn*, and make *zk* equal to *zn*; then will *k* be the Center of the Octagon. *Fourthly*, On *k*, with the Radius *kl*, deſcribe the Circle *lpabcdeg*, and ſet *pl* from *p* to *a*, from *a* to *b*, from *b* to *c*, from *c* to *d*, from *d* to *e*, from *e* to *g*, and from *g* to *l*; and then drawing the right Dines *pa*, *ab*, *bc*, *cd*, *de*, *eg*, and *gl*, they will complete the Octagon, as required.

PROBLEM XXII. Fig. LXXXIV.

To make a Regular Nonagon, whoſe Sides ſhall be each equal to a given Line, as e f.

PRACTICE. *Firſt*, On the Points *ef*, with the Radius *ef*, deſcribe the Arches *ee* and *ff*, interſecting each other in *a*. *Secondly*, Biſect *ef* in *h*, and draw *bh* through *a*. *Thirdly*, Divide the Arch *af* into two equal Parts at *z*, and make *ad* equal to *az*; then will *d* be the Center of the Nonagon. *Fourthly*, On *d*, with the Radius *df*, deſcribe the Circle *fegiklmnop*, and ſet *ef* from *e* to *g*, from *g* to *i*, from *i* to *k*, from *k* to *l*, from *l* to *m*, from *m* to *n*, from *n* to *o*, and from *o* to *f*; and drawing the right Lines *eg*, *gi*, *ik*, *kl*, *lm*, *mn*, *no*, and *of*, they will complete the Nonagon, as required.

PROBLEM

PROBLEM XXIII. Fig. LXXXV.

To make a Regular Decagon, whose Sides shall be each equal to a given Line, as e p.

PRACTICE. *First*, On the Points *ep*, with the Radius *ep*, describe the Arches *eb* and *cp*, intersecting in *a*. *Secondly*, Bisect *ep* in *d*, and draw *fd* through *a*. *Thirdly*, Divide the Arch *ap* in *z*; also divide *zp* into three equal Parts, and make *ae* equal to *ax*, (which is *az* and ⅓ of *zp*, equal to ⅔ of *ap*;) then will *e* be the Center of the Decagon. *Fourthly*, On *e*, with the Radius *ep*, describe the Circle *penghiklmo*, and set up *ep* from *e* to *n*, from *n* to *g*, from *g* to *h*, from *h* to *i*, from *i* to *k*, from *k* to *l*, from *l* to *m*, from *m* to *o*, and from *o* to *p*; and drawing the Lines *en*, *ng*, *gh*, *hi*, *ik*, *kl*, *lm*, *mo*, and *op*, they will complete the Decagon, as required.

PROBLEM XXIV. Fig. LXXXVI.

To make a Regular Undecagon, whose Sides shall be each equal to a given Line, as d e.

PRACTICE. *First*, On the Points *de*, with the Radius *de*, describe the Arches *db* and *ce*, intersecting each other in *a*. *Secondly*, Bisect *de* in *x*, and through the Point *a* draw the Line *fx*. *Thirdly*, Divide the Arch *ae* in *h*; also *he* into three equal Parts at the Points *no*; and then making *ag* equal to *ao*, the Point *g* will be the Center of the Undecagon. *Fourthly*, On *g*, with the Radius *ge*, describe the Circle *ediklmpqrst*; and set *de* from *d* to *i*, from *i* to *k*, from *k* to *l*, from *l* to *m*, from *m* to *o*, and from *o* to *p*; and drawing the Lines *id*, *ik*, *kl*, *lm*, *mp*, *pq*, *qr*, *rs*, *st*, and *te*, they will complete the Undecagon, as required.

PROBLEM XXV. Fig. LXXXVII.

To make a Regular Duodecagon, whose Sides shall be each equal to a given Line, as g f.

PRACTICE. *First*, On the Points *g*,*f*, with the Radius *gf*, describe the Arches *gb* and *cf*, intersecting each other in *a*. *Secondly*, Bisect *gf* in *x*, and through *e* draw the right Line *ex*. *Thirdly*, Make *ad* equal to *af*; then will *d* be the Center of the Duodecagon. *Fourthly*, On *d*, with the Radius *df*, describe the Circle *fghiklmnopqr*; and set *gf* from *g* to *h*, from *h* to *i*, from *i* to *k*, from *k* to *l*, from *l* to *m*, from *m* to *n*, from *n* to *o*, from *o* to *p*, from *p* to *q*, from *q* to *r*, and from *r* to *f*; and then the right Lines *hg*, *hi*, *ik*, *kl*, *lm*, *mn*, *no*, *op*, *pq*, *qr*, and *rf*, being drawn, will complete the Duodecagon required.

PROBLEM XXVI. Fig. LXXXVIII.

To describe all Manner of Polygons, whose Sides are required to be equal unto a given Line, as a e.

ON the Extremes of the given Line, as *a* and *e*, with the Length thereof, describe Arches, as *af*, and *be*, intersecting in 6. Bisect the given Line in *n*, and through *g* draw the Perpendicular *nd* at Pleasure, and divide the Arch *ge* into

into ſix equal Parts at the Points 1, 2, 3, 4, 5. This being done, you may deſcribe any Polygon as follows.

Firſt, Make the Diſtance 6, 5, on the Line *n d*, equal to $\frac{1}{6}$ of the Arch 6 *e*; then will the Point 5 be the Center of a Pentagon. *Secondly,* The Points *a*, 6, *e*, being equi-diſtant, therefore the Point 6 is the Center of a Hexagon. *Thirdly,* Make the Diviſions on the Line *nd*, from 6 to 7, 8, 9, 10, 11, 12, *&c.* each equal to $\frac{1}{6}$ of the Arch 6 *e*; and they will be the Centers of ſo many Polygons, whoſe Number of Sides will be always equal to the Number of Diviſions that the Center thereof is from the Point *e*.

$$\text{So the Center of a } \left\{\begin{array}{l}\text{Pentagon}\\ \text{Hexagon}\\ \text{Septagon}\\ \text{Octagon}\\ \text{Nonagon}\\ \text{Decagon}\\ \text{Undecagon}\\ \text{Duodecagon}\end{array}\right\} \text{ is at the Point } \left\{\begin{array}{c}5\\6\\7\\8\\9\\10\\11\\12\end{array}\right\}$$

$$\text{And Polygons of } \left\{\begin{array}{c}13\\14\\15\\16\\17\\18\\19\\20\\21\\22\\23\\24\end{array}\right\} \begin{array}{c}\text{Sides, have their Centers}\\ \text{at the Points}\end{array} \left\{\begin{array}{c}13\\14\\15\\16\\17\\18\\19\\20\\21\\22\\23\\24\end{array}\right\} \text{ on the Line } n\,d.$$

Now if on theſe Centers you deſcribe Circles, whoſe Radius's are equal to the Diſtances contained between them, and either of the Ends of the given Line *a* or *e*, you may, as before taught, ſet off therein, the Sides of the Polygon, or Polygons, required.

IF you conſider the Operations of the eight foregoing Problems, you can't help ſeeing the Reaſon thereof, which is very plain and eaſy to underſtand.

PROBLEM XXVII. Fig. LXXXIX.

To deſcribe any regular Polygon by Help of the Scale of Chords.

BEFORE we can proceed in theſe Operations, we muſt firſt diſcover, how many Degrees and Minutes are contained in the Side of the Polygon we deſign to deſcribe.

As for Example,

I WOULD deſcribe a Pentagon; which conſiſting of five Sides, muſt therefore therefore divide 360, the Number of Degrees in the Circumference of a Circle, by 5, the Number of Sides in the Pentagon, and the Quotient 72, is the Number of Degrees that are contained in each Side thereof.

 Now,

Now to describe the Pentagon Fig. XC. With 60 Degrees of your Scale of Chords, describe a Circle, as *cdbef*, and in its Circumference assume a Point, as at *f*; then taking 72 Degrees in your Compasses, and setting them from *f* to *b*, from *b* to *c*, from *c* to *d*, from *d* to *e*, and from *e* to *f*, and drawing the Lines *bf*, *bc*, *cd*, *de*, and *ef*, they will compleat a regular Pentagon as required.

Now since that we must first find the Number of Degrees that are contained in the Sides of those Polygons we design to represent, therefore observe,

That 360 being divided by	3	the Number of Sides in a	Triangle	the Quotient is	120
	4		Geom. Square		90
	5		Pentagon		72
	6		Hexagon		60
	7		Septagon		$51\frac{3}{7}$
	8		Octagon		45
	9		Nonagon		40
	10		Decagon		36
	11		Undecagon		$32\frac{8}{11}$
	12		Duodecagon		30

Which are the Number of Degrees contained in each of their respective Sides.

BY this Method you may instantly describe any Polygon in any Circle having its Diameter given, although you have but one Scale of Chords, as follows:

SUPPOSE I am to describe a Pentagon in the Circle *hiklg*, whose Diameter is much less than the Diameter of the Circle *bcdef*, whose Radius I suppose to be equal to the Radius of Scale of my Chords, by which I work.

PRACTICE. *First*, With 60 Degrees of my Scale of Chords, I describe the Circle *bcdef*, and therein compleat the Pentagon *bcdef*. *Secondly*, Draw the Lines *ab*, *ac*, *ad*, *ae*, and *af*, and on *a*, with the Radius of the given Circle, describe the Circle *hiklg*, which will intersect the Lines *ab* in *h*, *ac* in *i*, *ad* in *k*, *ae* in *l*, *af* in *g*; and then drawing the Lines *hi*, *ik*, *kl*, *lg*, *gh*, they will compleat the Pentagon, as required.

P. *Very well, Sir, I see the Reasons thereof; and can after that Manner perform any Polygon: But, suppose that the given Diameter of the Circle, in which I am to make my Polygon, be greater than the Circle* bcdef, *that's made by the Radius of my Scale of Chords; Pray how must I proceed at such Times?*

M. As following: Suppose the Radius of the small Circle *hiklg* to be equal to the Radius of your Scale of Chords, and that you were required to make a Pentagon in the great Circle *bcdef*; then having first compleated the Pentagon in the Circle *bcdef*, as before-taught, continue out the Lines *ab*, *ac*, *ad*, *ae*, *af*, at Pleasure; and on *a*, with the Radius of the given Circle, as *af*, describe a Circle, which will intersect the Lines *ab*, *ac*, *ad*, and *af*, in the Points *bcdef*, and then drawing the Lines *bc*, *cd*, *de*, *ef*, *fb*, they will compleat the Pentagon as required. And so in like manner may all other Kinds of Polygons be described.

P. *This Method, I apprehend, will do, when their Diameters are given; but when their Sides only are given, this Method or Rule will not do. Pray how must I proceed at such Times, to describe Polygons with the Scale of Chords.*

M. BEFORE

M. BEFORE you can enter upon the describing of Polygons by this Method, you must first observe, and always remember, that the three Angles of every Kind of Triangle, are exactly equal to 180 Degrees, (the Reason of which will be hereafter shewn in its Place;) and therefore, if from a Triangle, as *a f e*, you subtract the Angle, *e a f*, which contains 72 Degrees, (the Quantity of the Arch *f e*,) the Remains are 108; which are the Number of Degrees contained in the other two Angles *a f e*, and *f e a*: And whereas the Sides *a e* and *a f* being equal, therefore the Angles *a f e*, and *a e f*, are equal, each containing 54 Degrees, the half Part of 108. And since that every of the five Triangles *a f e*, *a f b*, *a b e*, *a c d*, *a d e*, are all equal to one another, therefore the Angle *b a f* is equal to the Angle *b f e*; that is, each 54 Degrees, and both being taken together, to 108 Degrees, which is the Quantity of the Angle *b f e*. Now to the Purpose:

Let a b. Fig. XCI. *be the given Side of a Pentagon.*

PRACTICE (1.) On each End of *ab*, with 60 Degrees of your Scale of Chords, describe Arches, as *f g*, *h i*, and therein from the Points *g* and *h*, set off 108 Degrees, from *g* to *f*, and from *h* to *i*, and through the Points *f* and *i* draw the right Lines *a e*, and *b c*, each equal to *a b*. (2.) At the Points *e* and *c*, perform the same Operations as at *a b*, and you will compleat the Pentagon as required; or otherwise, on the Points *e* and *c*, with the Distance *a b*, describe Arches, as *o o*, *m m*, intersecting in *d*, then drawing *e d*, *d c*, the Pentagon will be compleated as before.

P. *I observe you say I must set* 108 *Degrees on the Arches* f g, *and* h i: *Pray how can that be done, since that my Scale of Chords contains but* 90 *Degrees?*

M. First set off 90 Degrees on each Arch from *g* to *k*, and from *h* to *n*, and afterwards 18 Degrees from *k* to *f*, and from *n* to *i*, and then will *f g* and *h i* be each equal to 108 Degrees, the Angle of the Pentagon.

THIS being understood, you may describe any Polygon at Pleasure, whose Angles will be found to contain as following, *viz.*

The Angle of an	Hexagon	120	Degrees
	Septagon	$128\frac{4}{7}$	
	Octagon	135	
	Nonagon	140	
	Decagon	144	
	Undecagon	$147\frac{3}{11}$	
	Duodecagon	150	

PROBLEM XXVIII. Fig. XCII.

A Right Line being given, to find the Semidiameter of a Circle that shall be capable to circumscribe any given Polygon, whose Sides shall be equal to the given Line.

Let A B be the given Line.

PRACTICE. *First*, Bisect A B in K, and on K raise the Perpendicular K *m*. *Secondly*, With the Radius A B, on A and B describe the Arches A *k* and *b* B, intersecting in I; on which describe the Arch A 1 2 3 4 5 B, which divide into six Parts. *Thirdly*, Set one Foot of your Compasses on A, and extend the other unto the Point 1, and describe the Arch 1 *a*. *Fourthly*, Make I *n*, *n o*, I *p*, *p q*, *q r*,

qr, rs, st, tv, &c. each equal to A*a*; and then drawing the right Lines *o* B, *n* B, I B, *p* B, *q* B, *r* B, *s* B, *t* B, *v* B, they will be the Semidiameters of Circles, wherein may be defcribed any Polygon, as required, whofe Sides fhall be each equal to the given Line AB.

For the Line *o* B is the Diagonal of a Square.

And the Line	*n* B	the Semidiameter of a	Pentagon.
	I B		Hexagon.
	p B		Septagon.
	q B		Octagon.
	r B		Nonagon.
	s B		Decagon.
	t B		Undecagon.
	v B		Duodecagon.

PROBLEM XXIX. Fig. XCIV.

To defcribe a Spiral Line at any given Diftance, as the Right Line x x.

PRACTICE. Draw a right Line at Pleafure, as *ov*, and in any Part thereof affign a Point, as *r*, and thereon, with half *xx*, defcribe a Circle, as *qs*. This done, on *q* defcribe *sp*; on *r* defcribe *pw*; on *q* the Arch *wo*; and fo on thofe two Centers *q*, *r*, to as many Circumvolutions as you pleafe. If when on *q* you have defcribed the Arch *sp*, you make *s* your next Center, and thereon defcribe the Arch *pt*, the fpiral Diftance will be doubled, and admit of another Spiral to pafs by it at equal Diftance. For if on *s* you defcribe the Arch *qw*, and on *q* the Arch *wo*, you will form the fame Spiral from the Point *q*, reprefented by dotted Lines; as the Spiral from the Point *s*, which may both be revolved on the Centers *q*, *s*, at Pleafure.

WHEN fpiral Lines are continually open'd in their Revolutions, as Fig. XCIII. they are called Scrolls, (I fuppofe from their Manner of winding or turning themfelves up,) and may be fo defcribed, as following.

Firft, Draw a right Line at Pleafure, as *bn*, and therein affume a Point, as *g*, through which draw another right Line, as *am*, making an Angle of 45 Degrees. *Secondly*, Set off from *g* to *e*, from *e* to *d*, from *g* to *h*, and from *h* to *x*, any fmall Diftance, and let the Points *deghx* reprefent fo many Centers. *Thirdly*, On *g* defcribe the Arch *he*; on *h* the Arch *ei*; on *e* the Arch *ib*; on *x* the Arch *bl*; and on *d* the Arch *lb*; and fo on with other Centers added at the fame Diftance at Pleafure, you will complete the Spiral, as required.

Note, If on the Center *e* you defcribe the Arch *hc*, alfo on *x* the Arch *ck*, and on *d* the Arch *ky*, you will have produced a Lift or Fillet that may be continued about, whofe Breadth is equal to twice the Diftance of each Center: Therefore, whenever the Breadth of your Lift is determin'd, the Diftance of one Center from another will be exactly equal to half the Breadth of the given Lift.

LECTURE V. By S— S— Plates VI. VII.

On the Inscribing and Circumscribing GEOMETRICAL FIGURES.

P. *WHAT do you mean by Inscribing and Circumscribing Geometrical Figures?*

M. FIGURES are said to be inscribed within one another, when the Sides or Angles of the one, touch the Sides of the other; so a right-lined Figure is inscribed in a Circle, when all its Angles are in the Circumference of the same Circle: Or a Circle is inscribed in a right-lined Figure, when all the Sides of the Figure touch the Circumference of the Circle.

As for Example, Fig. XCVI.

THE Geometrical Square *fgik*, is inscribed in the Circle *fgiek*, because all its Angles are in the Circumference thereof. Also

THE Circle *nlme*, is inscribed in the Geometrical Square *nlme*, because all its Sides touch the Circumference thereof: and since that the Geometrical Square *bead* contains the Circle *nlme* within its Terms, therefore it is said to circumscribe the Circle *nlme*. And so likewise the Circle *nlme*, is also said to circumscribe the Geometrical Square *fgik*.

P. *I perfectly understand what it is to inscribe or circumscribe one Figure within or about another: Pray proceed to shew me how to perform the same.*

M. I will; in the following Problems.

PROBLEM I. Fig. XCV.

To inscribe a Circle in any kind of right-lined Triangle, as bco *in the Equilateral Triangle* ahf.

PRACTICE. *First,* By Problem V. Lecture II. divide any two Angles, as *ahf* and *afh*, into two equal Parts by right Lines, as *hc* and *bf*, intersecting each other in *g*. *Secondly,* On *g*, with the Radius *gc*, or *gb*, describe the Circle *bco*, as required.

DEMONSTRATION.

THE Triangles *gbh*, *gho*, have the Angles at *b* and *o* right-angled, and therefore equal; the Angles *ghb* and *gho* are also equal, because the Angle *bho* is divided by the Line *hc* equally: And since that the Line *hg* is common to the Triangles *bhg* and *gho*, therefore the Sides *bg* and *go* shall be equal. In the same Manner we may prove that *gc* is equal to *go*. Now seeing that *gb*, *gc*, and *go*, are equal; therefore, if on *g*, with the Radius *gc*, we describe a Circle, it shall pass through the Points *bco*: And because that that the Angles *b,c,o*, are right Angles, the Sides of the Triangle *ah*, *af*, *hf*, do touch the Circumference of the Circle in the Points *b, c, o*, only; and therefore the Circle *bco* is inscribed in the Triangle *ahf*. Q. E. D.

IN the very same Manner Circles are inscribed in all manner of Isoseles and Scalenum Triangles, as the Isoseles Triangle *kli*, and Scalenum *pqr*.

PROBLEM II. Fig. XCVI.

To inscribe a Circle within a Geometrical Square, as nlme *within* bcad.

PRACTICE. Draw the Diagonals *bd* and *ca* intersecting each other in *h*, from which let fall the Perpendicular *he*. Or otherwise, bisect the Sides in the Points *n, l, m, e*, and draw the Lines *nm* and *le*, which will also intersect in the Point *h*. This done, on *h*, with the Radius *he*, describe the Circle *nlme*; which will be inscribed in the Square *bcad*, as required.

DEMONSTRATION.

SINCE the Sides are bisected in *nlme*, therefore the Line *le* is parallel to *ba*, and *nm* to *ad*, and consequently the Angles which the Lines *nm* and *le* make with the Sides, will be all right Angles; and the Circle passing through the Points *n, l, m, e*, will touch all the Sides of the Square, and therefore is inscribed, as required.

PROBLEM III. Fig. XCVII.

To inscribe a Circle in any Regular Polygon, as in the Pentagon abcef.

PRACTICE. *First*, By Problem V. Lecture II. divide any two Angles, as *e* and *f* into two, equally by the Lines *ed* and *fd*, which being continued, will meet in the Point *d*; from whence let fall the Perpendicular *dg*. *Secondly*, On *d*, with the Radius *dg*, describe a Circle which will touch all the other Sides of the Polygon in the Points *i, k, l*, and if from *d* on *cf* you let fall the Perpendicular *dh*, it will be equal to the Perpendicular *dg*. In the same Manner, Perpendiculars being drawn from *g* unto the Lines *ae, ab*, and *bc*, they will be also equal, and all the Angles form'd thereby at the Sides, will be right Angles; and therefore if the Circle pass through the Ends of those Perpendiculars, it will touch every Side of the Polygon whereon they stand, and be inscribed within the Polygon. *Which was to be done.*

IN the same Manner, you may inscribe a Circle within the Hexagon B, Septagon A, or any other regular Polygon, as required.

PROBLEM IV. Fig. XCVIII. Plate VII.

To inscribe a Geometrical Square within any Triangle, as efdx *within* abc.

PRACTICE. *First*, On *bc*, at *c*, erect the Perpendicular *ch*, and make it equal to the Base *bc*. *Secondly*, From the Point *a*, let fall the Perpendicular *ag*, and draw the Line *hg*. *Thirdly*, Draw *ef* parallel to *bc*, through the Point *f*, also from the Points *e* and *f*, let fall the Perpendiculars *ed* and *fx*; then will *efdx* be the Geometrical Square inscribed, as required.

PROBLEM V. Fig. XCIX.

To inscribe an Equilateral Triangle in a Geometrical Square, as cbe *in* cadg.

PRACTICE. *First*, Draw the Diagonals *cgad*, and on the Center *n* describe the Circle *acdg*. *Secondly*, On the Point *g*, with the Radius *gn*, describe the Arch *hnf*, intersecting the Circle in *h* and *f*. *Thirdly*, Draw the Lines *ch* and *cf*, cutting the Square in the Points *be*; and then drawing the Line *be*, the Triangle *cbe* will be the equilateral Triangle inscribed, as required.

PROBLEM

PROBLEM VI. Fig. CIII.

To inscribe an Equilateral Triangle in a Pentagon, as beg *in* abdhi.

PRACTICE. *First*, On the Center *z*, with the Radius *zb*, describe the Circle *abdih*; and on the Point *b*, with the Radius *bz*, describe the Arch *xzc*. *Secondly*, Divide the Arches *zx* and *zc*, each into two equal Parts in the Points *mo*, through which, from the Point *b*, draw the Lines *bc* and *bg*, also the Line *eg*; then will *beg* be the equilateral Triangle inscribed, as required.

PROBLEM VII. Fig. CIV.

To inscribe a Regular Pentagon in an Equilateral Triangle, as dehfk *within* a, v, i.

PRACTICE. *First*, From the Point *v*, let fall the Perpendicular *vp*; and on *v*, with the Radius *vi*, describe the Arch *itsrqpom*. and divide the Arch *ip* into five equal Parts at the Points *qrst*. *Secondly*, Make *op* equal to *pq*, and draw the Lines *ao*, and *vo*. *Thirdly*, Divide *vo* into two equal Parts in *l*, and on *v*, with the Radius *vl*, describe the Arch *lk*, and draw the right Line *lk* unto *f*. *Fourthly*, Make *vg* equal to *if*, and draw *gk* cutting *ao* in *h*. *Fifthly*, On the Points *khn*, with the Radius *kh*, describe the Arches *hn*, *kd*, and *ke*, and make the Arches *kd*, *ke*, each equal to the Arch *hn*; then drawing the Lines *dh*, *de*, *en*, the Pentagon *defkh* will be inscribed in the Triangle *avi*, as required.

PROBLEM. VIII. Fig. CVI.

To inscribe a Geometrical Square within a Pentagon, as bcfh *within* eadgn.

PRACTICE. *First*, Draw the Line *ed*, and let fall the Perpendicular *ek*, which make equal to *ed*, and draw the Line *ak*, which will interfect the Pentagon in *f*. *Secondly*, Draw *fh* parallel to *gn*, and from the Points *f* and *h* erect the two Perpendiculars *fb* and *hc*; which will meet the Pentagon in *b* and *c*, and be also each equal to *fh*. *Lastly*, Draw the Line *be*, and the Square *bcfh* will be the Square inscribed, as required.

PROBLEM IX. Fig. CV.

To inscribe a Penta-Decagon, or Regular Polygon, consisting of 15 *Sides, within a given Circle, as* bacnf.

PRACTICE. *First*, Inscribe an equilateral Triangle within the Circle, as *agd*, *by* PROB. I. *hereof*, and also inscribe the Pentagon *bacfn*, so that the Angles meet in the Point *a*; then will *nd* be one third of *nc*: And since that *nc* is one fifth of the Circle, therefore *nd* is one fifteenth Part of the Circle, and Side of the Penta-Decagon, as required.

DEMONSTRATION.

SINCE the Line *ad* is the Side of an equilateral Triangle, or one Third of the Circle, equal to five Fifteenths, and the Arch *cd* being the fifth Part, it shall contain three Fifteenths, as *ce*, *ed*, and *dn*.

PROBLEM

PROBLEM X. Fig. CX.

To circumscribe a Circle about a Geometrical Square, as abce *about the Square* abce.

PRACTICE. Draw the Diagonals *be* and *ac*, intersecting in *d*, which is the Center; on which, with the Radius *db*, describe the Circle, as required.

PROBLEM XI. Fig. CIX.

To circumscribe a Geometrical Square about a Circle, as abcd *about the Circle* egfi.

PRACTICE. *First*, Draw a right Line, as *gi*, through the Center *h*; also the Right Line *fe*, at right Angles thereto. *Secondly*, Through the Points *fe*, draw the Lines *ab* and *cd* at right Angles to *fe*, and parallel to themselves: Also, through the Points *gi*, draw the Lines *ac*, *bd*, at right Angles to *gi*, and parallel to themselves also; which will intersect the former in the Points *abcd*, and complete the circumscribing Square, as required.

PROBLEM XII. Fig. CVIII.

To circumscribe a Pentagon about a Circle, as abcde *about the Circle* hwxgf.

PRACTICE. *First*, Inscribe a Pentagon within the Circle, as *hwxgf*, and divide every Side thereof into two equal Parts at the Points 1, 2, 3, 4, 5, through which, from the Center *z*, draw the right Lines *zb*, *zc*, *zd*, *ze*, and *za*; also draw the Lines *zh*, *zw*, *zx*, *zg*, *zf*. *Secondly*, Through the Points *h*, *w*, *x*, *g*, *f*, draw the right Lines *ab*, *bc*, *cd*, *de*, *ca*, at right Angles to the Lines *hz*, *wz*, *xz*, *gz*, *fz*, and they will intersect each other in the Points *a*, *b*, *c*, *d*, *e*, and form the circumscribing Pentagon, as required.

PROBLEM XIII. Fig. CVIII.

To circumscribe a Circle about a Pentagon.

PRACTICE. Bisect any two Sides thereof, as *ed* in *g*, and *ae* in *f*; and from the opposite Angles draw the Lines *cf* and *bg*, intersecting each other in *z*, which is the Center of the Pentagon. On which, with the Radius *zb*, describe the circumscribing Circle, as required.

PROBLEM XIV. Fig. CVII.

To circumscribe any Regular Polygon about another Polygon of the same sort, as the Hexagon lacegi *about the Hexagon* k, m, b, dfh.

PRACTICE. *First*, Draw the Lines *mf*, *bh*, *kd*, and through the Points *m*, *b*, *d*, *f*, *h*, *k*, draw the Lines *ac*, *ce*, *eg*, *gi*, *il*, *la*, at right Angles to the Lines *bh*, *dk*, *fm*; which will form the circumscribing Hexagon, as required.

PROBLEM

PROBLEM XV. Fig. CXI.

To circumscribe a Pentagon about an Equilateral Triangle, as aorvf *about* apk.

PRACTICE. *First*, With any Opening of your Compasses, on the Points *a,p,k*, describe Arches, as *bde*, *lki*, *mnq*. *Secondly*, Divide the Arch *cd* into five equal Parts; and on *c*, with the Radius equal to four of those Parts, describe the Arch *nxb*, and from *a*, through *b*, draw the right Line *abo*. *Thirdly*, Make the Arch *qm* equal to the Arch *gb*, and from *p*, through *m*, draw the right Line *ompr*, which will cut the Line *ao* in *o*; also make *or* equal to *ao*. *Fourthly*, Make the Arch *li* equal to the Arch *mq*, and from *k*, through *i*, draw the Line *fikv*, making *kf* equal to *op*, and *kv* equal to *pr*; then drawing the right Lines *af* and *rv*, they will complete the circumscribing Pentagon, as required.

PROBLEM XVI. Fig. CXII.

To circumscribe a Pentagon about a Geometrical Square, as noxz *about* 5lwv.

PRACTICE. *First*, Bisect 5*l* in *i*, and continue the Side *x*5 unto *d*, making 5*d* equal to 5*i*, and describe the Arch *defghi*, divide into five equal Parts at the Points *e,f,g,h*. *Secondly*, On *i* erect the Perpendicular *ik*, and through *g*, the second Division in the Arch *gi*, draw the right Line *b*5*n*. *Thirdly*, On the Points *wv*, with the Radius 5*i*, describe the Arches *rq* and *st*, and make *rq* and *st* each equal to *hi*, one Division or Part of the Arch *di*; and from the Points *wv*, through the Points *r* and *t*, draw the right Lines *ay*, *mz*, and *ay* will cut *nb* in *c*: Also from *n*, through *l*, draw *np* intersecting *mz* in *o*. *Fourthly*, Make *cx* and *oz* each equal to *nb* or *no*, and then drawing *xz*, the circumscribing Pentagon will be completed, as required.

PROBLEM XVII. Fig. C and CI.

To circumscribe a Geometrical Square about any Scalenum or Isosceles Triangle, as acmd *about* bmn, *or* achm *about* bnx. *This may be performed two Ways, as follows:*

PRACTICE I. *First*, Continue *mn* towards *d*, and through *b* draw *ac* parallel to *md*; also on *m*, erect the Perpendicular *ma*. *Secondly*, Make *ac* and *md* each equal to *am*, and then drawing *cd*, the circumscribing Square will be completed, as required.

PRACTICE II. *First*, Through the angular Point *b*, draw the right Line *ac* Parallel to *nx*; also through the Points *nx*, draw the right Lines *cm* and *ah*, at right Angles to the Line *nx*, and parallel unto themselves, intersecting the Line *abc* in the Points *ac*. *Secondly*, Making *cm* and *ah* each equal to *ac*, and drawing the right Line *hm*, the circumscribing Square will be completed, as required.

PROBLEM XVIII. Fig. CII.

To circumscribe a Geometrical Square about an Equilateral Triangle, as abmh *about* ain.

PRACTICE. *First*, Bisect any Side of the Triangle, as *in* in *k*, and draw *ak*; also continue out *in* both Ways towards *c* and *g*, and make *kg* and *kc* each

each equal to *ka*, and draw the Lines *ag* and *ac*. *Secondly*, Upon the Point *k*, with the Radius *kn*, deſcribe the Semicircle *nmi*, and continue *ak* unto *m*, from which, through the Points *i* and *n*, draw the right Lines *mnh* and *mib*; then will *abhm* be the circumſcribing Square, as required.

LECTURE VI. By Mr. &c.—— &c.——

On the various Methods of taking and drawing the GEOMETRICAL PLAN *aud* ELEVATION *of any Building, wherein the foregoing* LECTURES *are applied to Practice.*

M. BEFORE I proceed to the immediate Practice hereof, the three following Theorems muſt be underſtood.

THEOREM I. Fig. CXV.

IF two Triangles, as *efg* and *hnk*, have two Sides, of the one, equal to two Sides of the other; and the Angle in each Triangle that is formed by them both equal; then will the third Sides in both Triangles be alſo equal to each other, and both the Triangles will be equal: That is, if of the Triangles *efg*, and *hnk*, the Side *ef* is equal to the Side *hn*, and the Side *fg* equal to the Side *nk*, and the Angle *efg* equal to the Angle *hnk*; then I ſay, that the Side *eg* is alſo equal to the Side *hk*.

DEMONSTRATION.

IF the Point *h* be applied on the Point *e*, and the right Line *hn* placed on the right Line *ef*, the Point *n* ſhall fall on the Point *f*, becauſe *hn* is equal to *ef*.

ALSO the right Line *nk* ſhall fall on the right Line *fg*, becauſe *nk* is equal to *fg*. Likewiſe the Point *k* will fall on the Point *g*, and the right Line *hk* on the right Line *eg*, becauſe *hk* is equal to *eg*.

NOW ſeeing that all the Sides of each Triangle agree with the Correſpondents, conſequently the Triangle *efg* is equal to the Triangle *hnk*. *Which was to be demonſtrated.*

P. *Pray, to what Uſe is this Theorem apply'd? For at preſent, it ſeems to be of little Uſe, as many other Things I have learned in the preceding Lectures.*

M. ITS Uſe is very great; as alſo every Problem I have hitherto taught you, as will be preſently ſeen. But the Uſe of this Theorem I will now illuſtrate: Suppoſe *ab*. Fig. CXV. to be the Baſe Line of a Hill, or Diameter of a Concave, or large Pit or Pond of Water, whoſe Breadth is required, but cannot meaſure directly from *a* to *b*, to obtain the ſame.

PRACTICE. *Firſt*, Aſſign any Point on the Ground (being level) where you can ſee and meaſure to the Points *a* and *b*, as at *d*. *Secondly*, Meaſure off any Diſtance in ſtreight Lines from *d*, towards the Points *a* and *b*; as to the

the Points 1 and 2, suppose each 10 Feet; also measure the Distance contain'd between the Points 1 and 2; which note also. This done, on any other level Ground, make a Triangle, as 3, 4, *c*, Fig. CXIX. equal to the Triangle 1, 2 *d*, and continue out the Sides *c* 3, *c* 4, towards *a* and *b*, at Pleasure. *Thirdly*, Make 4 *b*, equal to 2 *b*, and 3 *a* equal to 1 *a*; then will the Triangle *abc*, be equal to the Triangle *adb*; because the Angle *acb*, is equal to the Angle *adb*; and consequently, the Distance of *ab*, Fig. CXV. is equal to the Line *a b*, of Fig. CXIX. which is the Distance required.

Now that you may never be at a Stand to know where to fix your Station Point, only observe, That if you can but have a free Access to the Extreams of the Line, whose Length is required, you are certainly right; for, if instead of the Point being chosen at *d*, had been at *z*, the Triangle *adb*, Fig. CXVIII. would have been equal to the Triangle *azb*, Fig. CXV. and consequently, the Distance of *a b* would be found as before.

THUS you see, how by making Triangles alike, an inaccessible Length or Distance may be taken or measured.

AN inaccessible Distance may be also found very readily, as following: Suppose *a b*, Fig. CXIX. to be inaccessible, and its Length is required.

PRACTICE. Assign any Point near thereunto, as *c*, in which fix down a Stake, and measure in a direct Line from *b* to *c*, forwards to *e*, making *ce* equal to *b c*; also measure in a direct Line from *a* to *c*, forwards to *x*; and make *c x* equal to *a c*; then will the Distance *e x* be equal to the Distance *a b*, as required; because the Angle *acb* is equal to the Angle *ecx*, that is, the opposite Angles are equal. Q. E. D.

THEOREM II. Fig. CXV.

That Triangle which hath one Side and two Angles equal to those of another, shall be equal thereto in every Respect.

LET the Angles *efghnk*, *egf*, *hkn*, of the Triangles *efghnk* be equal; and let the Sides *fg*, *nk*, contained between those Angles be also equal to each other; then I say, that their Sides are equal, that is, *eg* is equal to *h k*, and *ef* to *hn*: But, however, let it be supposed, that the Side *hk*, is greater than *eg*, and that *i k* is equal to *eg*, and draw the Line *in*.

DEMONSTRATION.

THE Triangles *efg*, *ink*, have the Sides *nk*, *fg*, *eg*, *i k*, equal, (by Supposition,) and the Angle *egf*, is also supposed equal to the Angle *ikn*. Now from thence, the Triangles *efg*, *ink*, should be equal in every Respect, and the Angles, *ink*, and *hnk*, should be equal also; that is, the Angle *i n k* should be equal to the Angle *hn k*; which cannot be, because it is less by the Angle *hni*; but according to our Hypothesis, the Angle *efg* is equal to the Angle *hnk*; and therefore *hk* cannot be greater than *eg*, nor *hn* greater than *ef*; because *fg* is equal to *n k*, and their respective Angles are equal. Q. E. D.

P. *'Tis true, Sir; by the foregoing Theorem, you have proved, that when the Sides of Triangles are equal, the Triangles themselves are also equal. Pray, to what Use may this Theorem be apply'd?*

M. To measure inaccessible Distances, which frequently happen in the Practice of taking Plans of Buildings, Lands, &c. where you are interrupted by Water, or other Persons Lands, on which you must not enter, but

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at the same Time must compleat your Plan or Survey: To effect which, the foregoing Theorem, together with this and the following Theorem, will enable you to wrestle with all such Difficulties with a great deal of Pleasure.

SUPPOSE I wanted to find the Breadth of the River *m x*, which cannot be measured by any Means; I then proceed to determine its Breadth, as following:

PRACTICE. *First*, Range out on the Ground a right Line as *x p*, and in any Part thereof, near the Side of the River, assign a Point, as at *o*; and thereon raise the Perpendicular *o l*, of any Length, at Pleasure; wherein also assign a Point in any Part thereof, as at *l*. *Secondly*, Sight or range in your Five or Ten Foot Rod, in a right Line between the Point *l*, and the Point *m*, (where the Line *p x*, being continued, cuts on the farther Side of the River;) at 5, 10, &c. Feet, or any other known Distance from the Point *l*, as at the Point 7: Also set the Distance of *l* 7, on the Perpendicular *o l*, from *l* to 8, and measure the Distance *l* 8. *Thirdly*, Make the Angle 8 *l* 9, equal to the Angle 7 *l* 8, and continue *l* 9, until it meet *x p* in *p*; then will the Triangle *p l o* be equal to the Triangle *m l o*; and if you make *o* 5 equal to *o x*, the Distance of 5 *p*, will be equal to *m x*, the Breadth of the River required.

THEOREM III. Fig. CXVIII.

If a Perpendicular be let fall from the right Angle of any right-angled plain Triangle on the Hypothenuse, it will divide the same into two Triangles, which will be alike thereto.

IF from the right Angle *s t q*, be drawn the Perpendicular *t r*, to the Hypothenuse *s q*, it will divide the right-angled Triangle *q t s* into two Triangles *q t r* and *r t s*, which shall be alike, or equiangular to the Triangle *q t s*.

DEMONSTRATION.

THE Triangles *q t s*, *q r t*, have the same Angle *q*, the Angle *q r t*, *q t s*, are both right Angles; and are therefore equiangular. In the same Manner the Triangles *t r q*, *q t s*, have the Angle, *s* common, and the Angles *q t s*, *t r q*, being right, they are also equal; therefore the Triangle *t r q* is similar, or proportionable in every Respect unto the Triangle *q t s*. Q. E. D.

THIS Theorem is also applicable to finding inaccessible Distances at one Station, as following:

Tis required to determine the Distance of r s.

PRACTICE. *First*, Range out on the Ground a right Line any Way from the Point *r*, as *r q*, and thereon, from the Point *r*, raise the Perpendicular *r t* of any Length. *Secondly*, Being furnish'd with a square Joint-Stool, Table, or a square Board only, as *b a t c*, place any Angle thereof, as *t*, on or perpendicularly over any assigned Point, as *t*. *Thirdly*, Turn one Side of the Square about, until by the Side thereof you see the Object or Point *s*, and in that Position let it remain fix'd, until by the other Side *t c* you have found the Point *q* in the Line *r q*; which is done by Sighting in an upright Staff placed at *q*, or by continuing on the Side *t c*, until it meets the Line *r q*.

Now

J

Now 'tis evident, that there is the ſame Reaſon or Proportion of tr to rg, as of tr to rs; therefore if tr be multiply'd into itſelf, and the Product divided by rq, the Quotient will be rs, the Diſtance required.

EXAMPLE.

SUPPOSE tr be 12 Feet, and rq, 6 Feet.

Then	12
Multiply'd by	12
Divide by	6)144(24
	12
	24
	24
	0

Now from the Conſideration of theſe *Theorems*, you may readily determine all inacceſſible Diſtances, as they occur or happen in Practice; which no Learner could imagine at his firſt Reading of the Theorems only: And it is the very ſame Thing with every other Problem of the preceding Lectures, as will now be declared: So that my witty Readers, who have ſaid, many of theſe Problems were uſeleſs, will be convinced that they have found Fault with what they have not underſtood; and which indeed, I believe, has been the only Cauſe of their ill-natur'd Cenſure: For none but the Stubborn, the Conceited, and the Ignorant, will condemn the Labours or good Intentions of others, or pretend to be Judges of a Knowledge, to which they are entire Strangers: Whilſt the judicious and thinking Man maturely conſiders, without Prejudice, the Reaſons and Cauſes of every Thing preſented to his Conſideration; and to ſuch only do I dedicate this Work.

PROBLEM I. Fig. CXIII.

To take the Quantity of an Angle in a Building, and delineate the ſame on Paper, &c. by the Help of a Two-Foot Rule, or Ten-Foot Rod only.

SUPPOSE I am to take the Angle ace, and repreſent the ſame on Paper.

PRACTICE. *Firſt*, From the angular Point c, meaſure off any Diſtance, as 10 Feet towards a, as to b; and from c towards e ſet off the ſame, or any other Diſtance, as to d, which is 15 Feet from c, becauſe of the Opening at A. *Secondly*, Carefully meaſure the Diſtance contain'd between the Points b and d, which note down on a Piece of Paper, and ſuppoſe to contain 20 Feet and ten Inches. This done, draw a right Line on Paper, at Pleaſure, as f B z, *Fig* CXVII and make fz equal to cd, 15 Feet, of any Scale of Feet. *Thirdly*, Take in your Compaſſes 20 Feet 10 Inches; and on the Point d, deſcribe the Arch bb; alſo on f, with the Diſtance of 10 Feet, deſcribe the Arch aa, interſecting bb in d, and draw the right Line fc through the Point d, then will the Angle cfz, be equal to the Angle acd; becauſe the Triangle dfz, is ſimilar to the Triangle bcd.

IN the ſame Manner, the Angles, hik and vxy are taken as following.

Firſt, SET off from the angular Point i, to h and k, any Number of Feet; ſuppoſe three Feet each, and meaſure the Diſtance hk, which let be four Feet and four Inches. This done, let the Line gy, *Fig.* CXVII. be drawn parallel to fz, at the ſame Diſtance from fz as gy, *Fig.* CXVII. is from ce, and make them both equal. *Secondly*, Make gk equal to gi; and on the Point k, with the Diſtance of three Feet, deſcribe the Arch hi. *Thirdly*, Make hi equal to four Feet four Inches, the Length of hk, and from k, *Fig.* CXVII. through i, draw the Line ki, and the Angle hki, will be equal to the Angle hik,

Fig. CXIII. Proceed in the ſame Manner with the Angle *w x y*, *Fig.* CXIII. and Angle *x 7 y*, *Fig.* CXVII. which will be equal to each other alſo.

Now you are to obſerve, by this Method, that all manner of inward or internal Angles may be very correctly taken, provided that the Diſtances you ſet off from the angular Point, be as great as poſſible, and not very ſhort; becauſe in long Lengths you will be more liable to Errors.

P. *Pray what do you mean by internal Angles?*

M. All ſuch Angles, whoſe Quantities are each leſs than 180 Degrees, as the Angle *a c e*, *Fig.* CXIII. whoſe Meaſure is the Arch DI, which is leſs than 180 Degrees, by the Arch PD; becauſe PD and DI, taken together, are but a Semicircle, or 180 Degrees. Of this Kind are the Angles A *t*, 1, 6, 9, 7, of *Fig.* CXIV. and K, *a*, 6, *v s n* of *Fig.* CXVI.

If the Arch D P *g* I be conſider'd without Side of the Angle DCI, it will be the Meaſure of the Complement of the internal Angle, and is called an external Angle, as being greater than a Semicircle, or 180 Degrees, by the Quantity of the Arch PD. Of this Kind are the Angles at *k*, *n*, 9, and *v*, in *Fig.* CXIII. and at *m*, *i*, *d*, *b*, *s*, and 9, in *Fig.* CXIV. as alſo are the Angles *n*, *k*, *a*, 6, *v*, and *s*, in *Fig.* CXVI.

Now the Manner of taking theſe external Angles, are exactly the ſame as before for internal Angles; which will appear by the following EXAMPLE.

'Tis required to take the Quantity of the external Angle i k n, Fig. CXIII. *and to delineate the ſame.*

Practice. *Firſt*, Apply your Ten-Foot Rod from the angular Point *k*, towards *m*, ſo that the End thereof reſt in a ſtraight Line with the Side *i k*, at *m*, at which Place make a Mark. *Secondly*, Remove the End of the Rod at *m*, along the Side *k n*, from the angular Point *k* unto *l*, at which Place make a Mark alſo; and then meaſure the Diſtance *m l*. This done, apply to your Paper-Drawing, and continue out *k i*, *Fig.* CXVII. towards *l*, and on the Point *i*, with a Radius of 10 Feet, equal to the Length of your Ten-Feet Rod, deſcribe the Arch *l m*, and make *l m* thereof equal to *l m* of *Fig.* CXIII. and then drawing the right Line *i n* through the Point *m*, and equal in Length to *k n*, you will have deſcribed the external Angle *k i n*, which will be equal to the Angle *i k n*, as required.

After the very ſame Manner are all the other Angles in *Fig.* CXIII. taken and delineated in *Fig.* CXVII. as alſo are the external Angles of *Fig.* CXIV. that are delineated in *Fig.* CXVI. which being ſo very plainly explain'd by the Lines themſelves, needs no farther Explanation.

Before I conclude this Problem, I muſt obſerve to you, That when internal Angles are very large, as to contain about 160, 170, or 178, *&c.* Degrees, there is ſome Difficulty to determine the real Points of Interſection. *As for Example:* I would take the internal Angles 7, 9, 6, and at 1 of *Fig.* CXIV. Now if I proceed, as before deliver'd, and ſet off equal Diſtances on each Side of each angular Point, as to *v* and *y*, at the Angle *t*, and to Z X, at the Angle 9; then the Subtendent Lines will be *v y* and Z X, which laſt is not vaſtly ſhorter than Z 9 and 9 X taken together, and therefore very liable to Error; which may be prevented by the following Methods:

METHOD

METHOD I.

First, BEING furnish'd with two Rods of equal Length, (the longer the better,) suppose each ten Feet; measure off one of their Lengths from the angular Point *a* unto *e*; at which Point apply one End of the other Rod, and bring both their other Ends to meet at the Point *w*, at which Place make a a Mark with a Stake, &c. *Secondly*, Keeping yet the Rod at the angular Point *t*, and the End of the other Rod being placed at *f*, bring both their Ends together in the Point *x*; and then will you have described two equilateral Triangles, whose Sides are severally equal unto 10 Feet. *Thirdly*, A Mark being made at *x*, remove away the Rod, and place it from *t* to *y*, and measure the Distance *y x*: And thus have you taken the Angle in three Parts, which is easily described on Paper as following:

PRACTICE. *First*, Suppose A *t* was a Line drawn at Pleasure on Paper, and made equal in Length to A *t*, by your Scale of Feet. *Secondly*, Take 10 Feet from your Scale of Feet, and therewith complete the two equilateral Triangles *t v w*, and *t w x*; and on *t*, with the same Radius of 10 Feet, describe the Arch *x n*. *Thirdly*, On *x*, with the Radius *x y*, describe the Arch *pp*, intersecting the former in *y*; and then drawing the Line *t* 1 through the Point *y*, you will very correctly lay down the Angle A *t* 1, as required.

METHOD II.

OBTUSE Angles of this Kind may be taken at twice, and very justly also. As for Example: I would take the Angle *k a* 6, of *Fig*. CXVI.

PRACTICE. *First*, Compleat one equilateral Triangle as before; as *e a f*, and make *a g* equal to *a f*; also measure *f g*. This done, let the same Line *k a* represent a given Line, and at the End *a*, compleat the equilateral Triangle *e a f*. *Secondly*, Take 10 Feet, &c. equal to the Side *a f*, and on *a* describe the Arch *n n* also on *f*, with a Radius equal to the measured Distance of *f g*, describe the Arch *m m*, intersecting the former in *g*. *Thirdly*, Through the Point *g*, draw the Line *a z*; which will compleat the Angle, as requir'd.

METHOD III.

SUPPOSE the obtuse Angle *n s v*, *Fig*. CXVI. is to be taken; which may be easily done as follows:

PRACTICE. *First*, Measure in a right Line from *v* towards *n*, and when you are come at *x*, directly opposite to the Angle *s*, there stop, and note your Length measur'd; which we will suppose to be 42 Feet. *Secondly*, From the angular Point *s*, let fall the Perpendicular *s x*, on the Line *x v*, and measure its Length, which suppose to be two Feet and six Inches; after which measure the Residue of the Length *n x*, which suppose to be 25 Feet. This done, delineate the Angle as following:

First, DRAW a right Line as *n v*, which make equal to 67 Feet, from your Scale of Feet, which is the Length of *n x* and *x v* taken together, and make *v x* equal to 42 Feet. *Secondly*, on *x*, erect the Perpendicular *x s*, which make equal to two Feet and a half; and then drawing the Lines *n s* and *s v*, they will compleat the obtuse Angle *n s v*, as required.

PROBLEM

PROBLEM I. Fig. CXXV.

The Out-Line of a Side of an irregular Building (as abeknos*) being given, to delineate a Plan thereof, as* tvbhnol.

PRACTICE. *First*, Draw a right Line at Pleasure, as *tx*, and make *tv* equal to *ab*, 13 Feet, (by your Scale of Feet and Inches,) and continue *ab* towards *c*. *Secondly*, Make the Angle *bvx* equal to the Angle *ebc*, as taught in Prob. XVII. Lect. II. and in the Use of Theorem III. Lect. VI. also make *bv* equal to *eb*, 16 Feet. *Thirdly*, Make the Angle *hbv* equal to the Angle *keb*, and the Side *bh* equal to the Side *ek*, 15 Feet. *Fourthly*, Make the Angle *bhf* equal to the Angle *ekg*, and continue *fh* towards *k*, making *hn* equal to *km*, 15 Feet. *Fifthly*, Make the Angle *hnw* equal to the Angle *kmo*, and make *no* equal to *mo*, 10 : 8. *Sixthly*, The Side *mo* being continued towards *q*, and the Side *no* towards *w*, make the Angle *low* equal to the Angle *soq*; and draw *lo* equal to *os*, 11 Feet 2 Inches; and then the Thickness *za*, being drawn parallel thereto, the Plan will be completed, as required.

PROBLEM II. Fig. CXXI. and CXXIII.

The Out Line of an irregular Building, as fabcde, Fig. CXXI. *being given, to delineate a Plan thereof, as* mghikl, Fig. CXXIII.

PRACTICE. *First*, Draw a right Line at Pleasure, as *nk*; and at one End thereof, as at *k*, make the Angle *nki* equal to the Angle *edc*: Also make *lk* equal to *ed*, 21 Feet 10 Inches, and *ki* equal to *dc*, 21 Feet. *Secondly*, Make the Angle *kih* equal to the Angle *dcb*, and make *ih* equal to *cb*, 30 Feet. *Thirdly*, Make the Angle *ihg* equal to the Angle *cba*, and make *gh* equal to *ab*, 32 Feet. *Fourthly*, Make the Angle *hgm* equal to the Angle *baf*, and make *gm* equal to *af*, 26 Feet 6 Inches. *Fifthly*, Make the Angle *gml* equal to the Angle *afe*; which, if your former Work be truly perform'd, will be done by joining *ml*, and *ml* will be also equal to *fe*, 19 Feet and 3 Inches, and complete the Plan, as required.

PROBLEM III. Fig. CXXII.

To take the Plan of the Out-Line of any irregular Building, without measuring any Side, or taking any Angle thereof; and inaccessible also, as the irregular Plan abcdefgnhiklmopq, *which is inviron'd with Water, and therefore none of its Sides or Angles can be measured; and yet a true Plan, with the just Measures thereof must be made, and that also with no other Instrument, than a common Five or Ten-Foot Rod, as being always to be had in any Place, and an Instrument, whose Aspect is not so astonishing to vulgar Eyes, as the* Plain Table, Theodilite, *and* Circumferentor; *whose Uses I shall very carefully explain, and compare with the Ten-Foot Rod*, &c. *in the Fifth Part hereof.*

THIS Plan may be most exactly taken by the three different Methods following.

METHOD I.

PRACTICE. *First*, Walk about the Building, and observe at how many Stations you can be capable of seeing all the Angles contain'd therein; for which Purpose, in this Example, I have assign'd four, as at the Points A, B, D, C; at which Places fix up Station-Staves, or Rods, about five Feet high, perpendicularly.

perpendicularly. *Secondly*, Being furniſhed with an Aſſiſtant, who muſt alſo be furniſhed with ſhort Station-Staves, or ſtrait Rods, about three Feet in Length, place yourſelf at one of the Stations, as C, and direct him in right Lines, between the Station C, and the ſeveral Angles *p*, *o*, *m*, *l*, *k*, *i*, *h*, *n*, *g*, to erect thoſe Staves or Rods at the Brink of the Water, as at the Points *x*, *x*, *x*, &c. *Thirdly*, Meaſure in a right Line from C, towards the Angle *p*, unto the Rod at *x*, which Length ſet down on a Piece of waſte Paper; and then find the Length of *xp*, as before taught in Theorem II. and III. hereof. This done, order your Aſſiſtant to ſtand in a right Line with yourſelf at *x*, and Station C, as at or about the Point 9, and meaſure in a right Line from C unto him, until you have meaſured firſt the Diſtance C 22 equal to C*x*, and afterwards from 22 unto 9, the Diſtance equal to *px*; then will the Diſtance C 9 be equal to the Diſtance C*p*. *Fourthly*, Meaſure from C, towards the Angle *o*, unto the Rod at *x*, which Length ſet down, and find the Length *xo*, which add unto C*x*; then direct your Aſſiſtant to ſtand in a right Line between *x* and C, as at or about the Point 8, and in a right Line from C unto him, meaſure off the Diſtance *o*C, as at the Point 8; then will the Diſtance of the Points 8 and 9 be equal unto the Diſtance of the Angles *p* and *o*. *Fifthly*, Meaſure from C, towards the Angle *m*, unto the Rod at *x*, which Length ſet down, as before; as alſo the Length *mx*, which you muſt find as aforeſaid, and add unto the other: Then direct your Aſſiſtant to ſtand in a right Line between *x* and C, as at or about the Point 7, and in a right Line from C unto him, meaſure off the Diſtance *m* C, as at the Point 7; then will the Diſtance of the Points 7 and 8, be equal to the Diſtance of the Angles D and *m*; and the Angle *l* 8 9 is equal to the Angle *pom*, but is reverſed. *Sixthly*, After the ſame Manner, make C 6 equal to *l*C; alſo C 5 equal to *k*C; alſo C 4 equal to *i*C; alſo C 3 equal to *h*C; alſo C 2 equal to *n*C; alſo C 1 equal to *g*C; and draw the right Lines 6, 7; 5, 6; 4, 5; 3, 4; 2, 3; and 1, 2; which will be equal to the Sides of the Building *ml*, *lk*, *ki*, *ih*, *hn*, and *ng*; but are reverſed, as before obſerved.

Now, to repreſent them in their true Poſitions, we muſt reverſe them again; which is done as following.

Assign a Point in any Part of the Area before them, as at F; through which, from the ſeveral Angles before found, as at 1, 2, 3, 4, 5, 6, 7, 8, 9, draw right Lines at Pleaſure, and make F 18 equal to 1 F; alſo F 17 equal to 2 F; alſo F 16 equal to 3 F; alſo F 15 equal to 4 F; alſo F 14 equal to 5 F; alſo F 13 equal to 6 F; alſo F 12 equal to 7 F; alſo F 11 equal to 8 F; and laſtly, F 10 equal to 9 F: And then drawing the right Lines 10, 11; 11, 12; 12, 13; 13, 14; 14, 15; 15, 16; 16, 17; and 17, 18; they will be exactly equal to the Sides of the Building *po*, *om*, *ml*, *lk*, *ki*, *ih*, *hn*, and *ng*; and the ſeveral Angles at 10, 11, 12, 13, 14, 15, 16, 17, and 18, will be the very ſame as thoſe of the Building at *pomlkihng*

This being underſtood, which is very eaſy to do, you may at the Station D, in the ſame manner, find the Sides *ba*, *aq*, *qp*, and *po*; which laſt Side, tho' taken before at Station C, muſt be now again taken to find the Angle *qpo*, otherwiſe we could not truly join the Sides *ba*, *aq*, and *qp*, unto the others before taken in their true Poſitions. Which ſaid Sides, by the firſt Reverſion, will be 1, 2; 2, 3; 3, 4; and 4, 5: And then aſſigning at Pleaſure the Point 6, by reverſing them again through the ſaid Point, as before taught, the Lines GH, HI, IK, will be equal to the Sides of the Building *ba*, *aq*, *qp*, and *po*; as alſo will the Angles H, I, K, be equal to the Angles *a*, *q*, *p*, and in a right Poſition alſo.

IN the ſame Manner, P, O, N, M, L, will be found equal to the Sides *q*, *a*, *b*, *c*, *d*; and R, S, T, V, W, equal to *c*, *d*, *e*, *f*, *g*; and ſo will you have taken all the Sides and Angles of the given Building, without once meaſuring any Part thereof.

THE next Work, is the Manner of connecting them together into an entire Plan.

Which perform as following. Fig. CXXIV.

PRACTICE. *Firſt*, By PROB. I. hereof, make *b*, *c*, *d*, *e*, *f*, *g*, *h*, *i*, *k*, equal to 10, 11, 12, 13, 14, 15, 16, 17, of Fig. CXXII. and becauſe that the Sides KQ, and 10, 11, are the ſame, therefore on *b*, Fig. CXXIV. make the Angle *abc* equal to the Angle IKQ; and then make *baqp* equal unto KIHG. *Secondly*, GH and NO being the ſame Side, (equal unto *ba* of the Building,) therefore make the Angle *pqa* equal unto the Angle GHI, which is alſo equal to the Angle NOP; and then make *pon* equal to NML. *Thirdly*, ML and RS being the ſame Side equal unto *cd* of the Building, therefore make the Angle *onm* equal unto the Angle RST, and make *nmlk* equal to STVW; and if that you have truly perform'd, the Line VW, which in your Drawing is the Line *kl*, will cloſe up your Plan at *k*, as required.

AS this Method of meaſuring Plans is intirely new, I make no doubt but that the carping Critick will make his Obſervations and Reflections thereon, and Objections againſt it. But that he may not have all the Trouble thereof, I will, for his Eaſe, make the firſt Objection, and then refer the Remainders, if any, for him to diſcover.

OBJECTION.

TO diſcover the real Length of the Sides, and the Quantity of the Angles of Buildings by this Method, much Space or Room about it is required for the Operation, and the Ground to be very nearly ſmooth or level, otherwiſe 'tis not practicable; and this is the only Objection that I know of can be made againſt it. For where there is Room ſufficient, and the Ground nearly level, it is infallible, if Care be taken in the Operation.

N.B. And ſince that oftentimes we may not have Room ſufficient for the Practice of this Method, I ſhall therefore ſhew how to perform the ſame Work in leſs Space with a Ten-Foot Rod only, as aforeſaid. But however, let not the foregoing Method be rejected, ſince that on ſome Occaſions it may be of very great Uſe to you, as I in Practice have often experienced.

METHOD II. Fig. CXXII.

Firſt, Aſſign the proper Stations, as A, B, D, C, and then begin at any one thereof, as at C, as follows. *Secondly*, Let your Aſſiſtant fix up two ſmall Station-Rods, or Staves, at the Points X and 10, at any equal Number of Feet diſtance from C, as 10, 20, &c. and in right Lines between the Stations DC and BC. *Thirdly* Being provided with a Ten-Foot Rod, and a Line long enough for the Purpoſe, apply one End of the Line unto the Rod at X, and ſtrain it by the other Rod at 10, as nearly level as you can. *Fourthly*, On two Sticks ſet up, as *ab*, *bd*, Fig. CXXVI. hang a Plum-Line as *bc*, ſo that the Bob *c* hang exactly over the Station-Point C; and your Aſſiſtant having another Plum-Line alſo, cauſe him to hold it up by the Side of the Line, moving it backwards and forwards, until you have directed him, in a right-lined Poſition, between the ſeveral Angles *p*, *o*, *m*, *l*, *k*, *i*, *h*, *n*, *g*, and the Plumet over

the Station C; at every of which Time, let him exactly mark the Side of the Line X 10, and meaſure the Diſtance from X, as at the Points 1, 2, 3, 4, 5, 6, 7, 8, 9, 10. *Fifthly*, Meaſure the ſeveral Diſtances from the Station at C, unto the Angles *po*, *lmk*, *ihng*, and enter them down in a Book for that Purpoſe, as follows.

		Feet.	Inch.			Feet.	Inch.
The Diſtance from the Station C, unto the Angle	*p*	71	0	And Quantity of Angles on the Line, from X to	1	4	4
	o	57	6		2	5	4
	m	47	3		3	9	5
	l	37	9		4	13	8
	k	26	0		5	16	3
	i	32	7		6	22	0
	h	47	0		7	23	10
	n	64	4		8	29	6
	g	68	0		9	32	0

Sixthly, Proceed in the like Manner at the other Stations D, A, B, and enter them accordingly. Which being done, you may delineate from your Book a true Plan thereof, as following.

Firſt, Conſider to what Magnitude you would make your Drawing, and accordingly proportion the Size of your Scale. Which being done, draw a right Line at Pleaſure, as *wx*, Fig. CXXIV. which make equal to the meaſured Diſtance of your Stations D and C, 89 Feet; and on *r*, with the Radius of 26 Feet, equal to XC, deſcribe an Arch as *ry*, and thereon ſet 34 Feet from *r* to 10, which is equal to X 10, the Meaſure of the Angle DCB, and draw the Line *r* 10. *Secondly*, Make the Diviſion *r* 1, *r* 2, *r* 3, *r* 4, *r* 5, *r* 6, *r* 7, *r* 8, *r* 9, equal to the Quantity of the Angles obſerved and meaſured by the Side of the Line, and enter'd in the laſt Column of the Table; that is, make *r* 1 equal to X 1, and draw *bx* equal to 71 Feet, the Diſtance of the Angle *p* from the Station C; alſo make *r* 2 equal to X 2, and draw *cx* equal to 57 Feet 6 Inches, the Diſtance of the Angle *o* from the Station C, and ſo in like manner the others: Which, when done, you will have produced the Points *b*, *c*, *d*, *e*, *f*, *g*, *h*, *i*, *k*; and then the right Lines *bc*, *cd*, *de*, *ef*, *fg*, *gh*, *hi*, and *ik*, being drawn, will be the Sides *po*, *om*, *ml*, *lk*, *ki*, *ih*, *hn*, *ng*, which are Part of the given Plan. *Seventhly*, Begin again at the next Station D, and proceed in every Reſpect as at C; after which, ſet off the ſame by your Scale of Feet at *w*, Fig. CXXIV. In like manner proceed at the Stations A and B, and ſet off the ſame at *v* and *t*, and you will have completed the Plan within the Limits of A, B, D, C, as required.

Note, When Lines of Diſtance from the Station-Points falls very obliquely on the Sides of the Building, as *p*C and *o*C on the Side *po*, 'twill be beſt to make Off-ſets, as *go* and *hp*, from the Line DC, whoſe Lengths may be found by Theorem II. and III. and will determine the angular Points *p* and *o* with Certainty, that is not ſo eaſily done by the foregoing Directions.

THE like is to be obſerved at the Angles of the Building *ab*, *cd*, which are in general determin'd in this Manner, in *Fig.* CXXIV. as appears by the Iſoſeles Triangles at the Angles *cb*, *qp*, *on*. The whole being ſo very plainly exhibited by the Lines of the Diagrams, it is therefore needleſs to ſay further thereof.

IRREGULAR Inacceſſible Buildings may be alſo plan'd as following.

METHOD III. Fig. CXX.

Let a b c d e f g h i k l m n o *be the Out-Line of a Building, environ'd with Water, and 'tis required to make an exact Plan thereof.*

PRACTICE. *Firſt*, Aſſign about the ſame a ſufficient Number of Stations, as *q r s t*, *v p*, at which Places fix down Stakes, &c. and with your Ten-Foot Rod meaſure the Diſtance between each; and alſo take the Angle at every Station, as is made by the right Lines contain'd between them. *Secondly*, By PROB. II. hereof, lay down a Plan of the Stations and Lines between them, (which we will ſuppoſe to be the Plan *q r s*, *p v t*.) *Thirdly*, Being provided with the ſame ſquare Board, or Joint-Stool, as directed for the Uſe of finding Inacceſſible Diſtances in Theor. II. and III. apply one Side thereof unto the Line *p v*, and move it along the ſame, until by the other Side you ſee the Angle *n*; then by its Side, oppoſite to the Angle, draw the Line 1, 15. In the ſame Manner, perform again at every other Angle as at the Points 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14; and then will the Lines *n* 1, *o* 2, *a* 3, *b* 4, *c* 5, *d* 6, *e* 7, *f* 8, *g* 9, *h* 10, *i* 11, *k* 12, *l* 13, *m* 14, be ſo many Off-ſets, whoſe ſeveral Diſtances on every reſpective ſtationary Line, being truly placed according to their Meaſures found, and Length diſcover'd by Theorem II. and III. being made correſpendently equal; then Lines being drawn unto the ſame, will complete the Plan, as required, as in the Figure is moſt plainly ſeen, by the ſeveral Lines that conſtruct the ſame.

THEOREM IV. Fig. CXVIII.

Equiangular Triangles have their Sides proportional.

IF the Triangles *w x y*, 1 *y z*, are equiangular, that is to ſay, that the Angles *w x y*, 1 *y z*; *x w y*, *y* 1 *z*, be equal, there will be the ſame Reaſon of *x w* to *x y*, as of *y* 1 to *y z*. In like manner, the Reaſon of *x w* to *w y*, ſhall be the ſame with that of *y* 1 to 1 *z*.

CONTINUE the Sides *x w*, and *z* 1, until they meet in *v*; and becauſe the Angles *w y x*, and 1 *z y*, are equal, therefore the Sides *w y* and *v z* are parallel; as alſo are the Sides *v x* and 1 *y*.

DEMONSTRATION.

IN the Triangle *v x z*, *w y* is parallel to the Hypotheneuſe *v z*, and therefore there ſhall be the ſame Reaſon of *x w* to *w v*, as of *x y* to *y z*; alſo there ſhall be the ſame Reaſon of *w x* to *x y*, as of 1 *y* to *y z*. In like manner, 1 *y* being parallel to the Perpendicuar *v x*, there ſhall be the ſame Reaſon of *v* 1 to 1 *z*, as of *x y* to *y z*; and alſo of *w y* to *x y*, as of 1 *z* to *y z*.

HENCE 'tis evident, that the Parts of Equiangular Triangles are reſpective ly proportional to one another.

THIS being underſtood, we will now proceed further, on divers other Methods for Taking and Delineating of Plans, as they may variouſly occur unto us in our Practice.

PROBLEM

PROBLEM IV. Fig. CXXVIII.

To take the Plan of an Irregular Curved Line, as AB.

BEFORE you begin to take the Plan of any Lands or Buildings, walk over the ſame, and make, as you go, a rough Draught of the ſame at Gueſs, as nearly true as you can, on a Piece of Paper, ſignifying therein every Side and Angle, without any Regard being had to the Exactneſs thereof; which you are to call an *Eye-Draught*, (as being made by the Eye only, without any Meaſurement for forming of the ſame,) whoſe Uſe is, for to receive on its ſeveral Sides an Account of their Lengths, as alſo of their reſpective Angles: From which you are enabled to delineate an exact Plan of the Premiſes meaſured; which is called by Artizans, *The Taking of a Plan.*

PRACTICE in the Field: Firſt, aſſign two Points, as *as*, on which erect two Sticks; and then ſuppoſe a right Line to be drawn between them, which alſo repreſent on your Paper. *Secondly,* In the Line *as*, and againſt every remarkable Turning in the Curve, as at the Points *b, c, d,, e, f g, h, i, k, l, m, n, o, q, q, r*, fix down ſmall Sticks, and meaſure from each of them, as nearly at right Angles as you can, from the Line *as*, unto the Curve; and to each of them, in your Eye-Draught, affix its true Length, as alſo its true Diſtance from the Point *a*: *Or otherwiſe*, beginning at *a*, meaſure towards *s*, until you come at *b*; which, ſuppoſe to be 11 Feet, which ſet down in your Eye-Draught; and then meaſure the Off-ſet *bt*, (as nearly ſquare from *ab* as you can,) which ſuppoſe to be 15 Feet, which ſet down thereto in your Eye-Draught, as in the Figure. This done, proceed towards *s*, until you come to *c*, where you ſuppoſe 'tis neceſſary to take a ſecond Off-ſet; whoſe Diſtance from *a*, ſet down thereto in your Eye-Draught, and then meaſure the perpendicular Off ſet *v,c*, ſuppoſe to be 30 Feet, which ſet down alſo as in the Figure. Proceed in like Manner, to take all the Reſidue of the Off-ſets, as ſhall be judged neceſſary for the Purpoſe, (the more, the better,) and then you may delineate the ſame truly, as following:

PRACTICE on the Paper: Draw a right Line at Pleaſure, as *as*, and with any Scale of Feet, as you ſhall make choice of,

			Feet.				Feet.
Make	*ab*	equal to	11	and the Off-Set	*bt*	equal to	15
	ac		22		*cv*		30
	ad		32		*dw*		34
	ae		43		*ex*		31
	af		51		*fy*		32
	ag		62		*gz*		38
	ah		74		*h*1		39 : 6
	ai		86		*i*2		37
	ak		98		*k*3		31
	al		114		*l*4		28
	am		122		*m*5		31
	an		132		*n*6		37
	ao		142		*o*7		38
	ap		151		*p*8		35
	aq		159		*q*9		27
	ar		165		*r*10		26

And though the Extreams thereof, *t, v, w, x, y, z,* 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, draw, or trace the curved Line required.

PROBLEM V. Fig. CXXIX.

To make the Plan of a Piece of Land bounded by an irregular curved Line, as b, d, e, f, h, l, p, *which may be seen from one Station in or near the Middle thereof.*

PRACTICE *in the Field: First,* Make an Eye-Draught thereof, and in its Sides assign four Points, as *b, e, h, k*; in which erect four Station-Staffs, and represent the same in your Eye Draught, and therein also draw Lines representing *b e, e h, h k,* and *bk,* whose Lengths being severally measured, and the Of-Sets that are necessary for the taking of the Curve, being taken, as before taught in the last Problem, you may proceed to the Delineating a true Plan thereof, as following:

PRACTICE *on Paper.* By *Prob.* II. of LECT. IV. make the Triangles *e h k* and *e b k,* that their respective Sides shall be equal to the Measures thereof taken and expressed in your Eye-Draught; that is to say,

Feet.

$$\text{In the Triange } e\,h\,k, \text{ the Side} \left\{ \begin{array}{c} e\ h \\ e\ k \\ k\ h \end{array} \right\} \text{ to be equal to } \left\{ \begin{array}{c} 75 \\ 91 \\ 69 \end{array} \right.$$

$$\text{And the Triangle } b\,e\,k, \text{ the Side} \left\{ \begin{array}{c} e\ k \\ b\ e \\ b\ k \end{array} \right\} \text{ to be equal to } \left\{ \begin{array}{c} 91 \\ 89 \\ 77 \end{array} \right.$$

Wherein observe, That the Side *e k* is common to both the Triangles *b e k* and *e h k,*. Lastly, Measure and set off every Off-set, as they have occurr'd, and through their Extreams, draw or trace the curved Boundary, as, required.

PROBLEM VI. Fig. CXXX.

To take the Plan of a Piece of Land, bounded by divers unequal Sides, whose Angles cannot be all seen from any one Point taken within the same; as a, b, c, d, e, f, g, h, i, k, n, l, m.

NOTE, When the Out-Lines of Lands or Buildings cannot be all seen from one Station, we must have Recourse unto two, or more Stations, in Manner following:

PRACTICE *in the Field. First,* Go about the Out-Line, and make an Eye-Draught thereof, and draw Lines from Angle to Angle, to divide the same into Triangles, as in the Figure. *Secondly,* Measure every Side, and note it down in your Eye-Draught on every Side, as in the Figure; and then proceed to delineate the same, as following:

PRACTICE *on Paper. First,* Draw a right Line, to represent *a c,* equal to 72 Feet 10 Inches, by your Scale of Feet, and by Problem II. *Lect.* IV. compleat the Triangle *a b c,* making *a b* equal to 30 Feet, and *b c* equal to 47 Feet: *Or otherwise,* If at *o* you had taken the Off-set *b o,* and made it equal to 24 Feet, 6 Inches, at 32 Feet distance from *a,* and drawn the Lines *b a,* *b c,*

b, c they would alſo have compleated the Triangle *b a c*, as before; and which is ſometimes neceſſary to be ſo perform'd, when, by Water, or other Impediments, we cannot meaſure from *a* to *b*, or from *b* to *c*. *Secondly*, On the Line *a c*, compleat the Triangle *a c n*, making the Side *a n*, equal to 60 Feet, and the Side *c n* equal to 40 Feet; alſo on the Line *a n*, at *p*, 21 Feet Diſtance from *n*, ſet off the Off-ſet *p l*, equal to 24 Feet, and compleat the Triangle *a l n*: Likewiſe on the Line *a l*, compleat the Triangle *a m l*, making the Side *a m* equal to 24 Feet, and *m l* equal to 34 Feet; and then will you have deſcribed the Sides *n l*, *l m*, *m a*, *ab*, and *b c*, and their ſeveral Angles alſo. *Thirdly*, On the Line *c n*, compleat the Triangle *c e n*, making the Side *c e* equal to 71 Feet, and Side *n e* equal to 75 Feet 6 Inches: Alſo on the Side *c e*, at *q*, 42 Feet Diſtance from the Angle *c*, ſet off the Off-ſet *q d*, 24 Feet, and compleat the Triangle *c, d, e*. *Fourthly*, *n k*, being ſuppoſed in your Eye-Draught to be continu'd to *r*, and equal to 38 Feet, therefore on the Line *n e* compleat the Triangle *n e r*, making *n r* equal to 38 Feet, as aforeſaid, and *r e* equal to 70 Feet: Alſo continue *e r* to *i*, making *r i* equal to 18 Feet, and *r k* equal to 6 Feet, and draw the Side *k i* 19 Feet, which will compleat the Triangle *k r i*. *Fifthly*, On the Line *e i*, compleat the Triangle *e i h*, making *i h* equal to 63 Feet 10 Inches, and Side *e h* to 77 Feet 10 Inches: Alſo on the Line *e h* compleat the Triangle *e g h*, making the Side *e g* equal to 43 Feet, and Side *g h* equal to 53 Feet. *Laſtly*, on the Line *e g*, at the Point *s*, 31 Feet from the Angle *e*, ſet off the Off-ſet *s f*, equal to 10 Feet, and draw the Sides *e f* and *f g*; which will compleat the Plan as required.

BY this Method, if Care is taken in meaſuring truly from one Angle to the other, you may moſt correctly take and delineate any ſuch irregular Plan that may be required.

PROBLEM VII. Fig. CXXXI.

A Piece of Land (intended to be built on,) which is ſo very irregular, as not for to ſee all its Angles, under leſs than three Stations; as A 1, 2, 3, 4, 5, 6, 7, 8, w F x y 15, 14, 13, 12, 11, 10. 9, *being given; to make a Plan thereof by Off-ſets, taken from ſtationary Lines, directed through any Part thereof at Pleaſure, unto the ſeveral Angles thereof.*

PRACTICE *in the Field*. *Firſt*, Walk about the Out-Lines or Bounds, and make an Eye-Draught thereof. *Secondly*, Erect a Station-Staff in any of the End-Angles, as at A; alſo another in any Part of the Field, as at B; alſo another, as at D; likewiſe another, as at E; and, laſtly, another, as at F: Which ſaid Station-Points do you repreſent in your Eye-Draught, and draw right Lines from one to the other, as in the Figure. This done, meaſure from A towards B, and againſt the Angle 9, take the Off-ſet, *b* 9, expreſſing its Length 18 Feet, and Diſtance from A 20 Feet. Then proceed forwards from *b* towards B, until you come againſt the Angle 10, at *c*; and take the Off-ſet *c* 10, 14 Feet, and Diſtance from A 35 Feet. Again, go forwards towards B, and againſt the Angle 2 at *x*, take the Off-ſet *x* 2, 8 Feet, and Diſtance from A 48 Feet: Alſo go forwards, and at *d*, take the Off-Set *d* 11, 36 Feet, and Diſtance from A, 67 Feet. Continue A B towards C, and at *e*, take the Off-ſet *e* 3, 26 Feet, and Diſtance from A 93 Feet. *Thirdly*, At any Diſtance from B, ſuppoſe 16 Feet, make a Mark in the Line A C, at *h*, and at the ſame Diſtance from B, ſight in a Station-Staff *g*, and meaſure the Line *g h* very exactly, which ſuppoſe to be thirteen Feet: All which, enter down in your Eye-Draught on their reſpective Places. *Fourthly*,

meaſure

Meaſure from B towards D, and againſt the Angle 4, at *f*, take the Off-ſet *f* 4 31 Feet, and Diſtance from B 28 Feet. Again, go on towards D, and againſt the Angle 5, at *w*, take the Off-ſet *w* 5 14 Feet, and Diſtance from B 45 Feet. Alſo go on towards D, and againſt the Angle 12, at *i*, take the Off-ſet *i* 12 42 Feet, and Diſtance from B 47 Feet. Likewiſe meaſure forwards to *k*, and there take the Off-ſet *k* 6 15 Feet, and 62 Feet from B. Laſtly, Meaſure towards D, and at *n* take the Off-ſet *n* 13 28 Feet, and Diſtance from B 88 Feet. *Fifthly*, Set back 16, or any other Number of Feet from D to *l*, and at the ſame Diſtance from D, ſight in a Station-Staff at *m*, and meaſure *lm* very exactly, which ſuppoſe to be 22 Feet. All which Particulars do you enter down in your Eye-Draught, on their reſpective Places. *Sixthly*, Meaſure from D towards E, and againſt the Angle 14, at the Point *o*, take the Off-ſet *o* 14 10 Feet, and Diſtance from D 2 Feet. Go on towards E, and againſt the Angle 7, at *p*, take the Off-ſet *p* 7 20 Feet, and Diſtance from D 51 Feet. Likewiſe meaſure on towards E, and againſt the Angle 15, at *h*, take the Off-ſet *h* 15 15 Feet, and Diſtance from D 60 Feet. Laſtly, Meaſure home to E, whoſe Length from D let be 84 Feet. This done, ſet 16 Feet back from E towards D, on the Line DE at *q*, and at the ſame Diſtance from E towards F, at *s*, ſight in a Station-Staff, and meaſure the Diſtance *s q* very exactly: All which carefully enter down in your Eye Draught. *Seventhly*, Meaſure from E towards the laſt Station F, and againſt the Angle *y*, take the Off-ſet *ry* 21 Feet, and Diſtance from E 5 Feet. Alſo meaſure on, and againſt the Angle 8, take the Off-ſet *t* 8 21 Feet, and Diſtance from E 36 Feet. This done, meaſure home to the Station Point F, 62 Feet, and ſet any Number of Feet back from F to *v*, ſuppoſe 11 Feet, and meaſure *wv*, which let be 21 Feet; alſo *vx*, which let be 17 Feet. Laſtly, Meaſure *w*F 18 Feet, and F*x* 15 Feet. Which Dimenſions being carefully entered down in the Eye-Draught, you may moſt exactly delineate the Plan thereof as following.

PRACTICE *on the Paper*. *Firſt*, Draw a right Line at Pleaſure, as ABC, making AB equal to 93 Feet. *Secondly*, Set 16 Feet from B to *h*, and on B*h* complete the Triangle B*hg*, making B*g* equal to 16 Feet, and *gh* equal to 13 Feet. *Thirdly*, Continue B*g* unto D, making BD equal to 99 Feet, and ſet 16 Feet back from D to *l*. *Fourthly*, On the Line *l*D, complete the Triangle *lm*D, making the Side *lm* equal to 22 Feet, and D*m* to 16 Feet; and continue D*m* unto E, making DE equal to 84 Feet, and ſet back 16 Feet from E to *q*. *Fifthly*, On the Line *q*E, complete the Triangle *qs*E, making the Side *qs* equal to 27 Feet, and the Side *s*E equal to 17 Feet; and continue E*s* unto F, making EF equal to 62 Feet: And thus will you have laid down all your Station-Lines ready for ſetting on the ſeveral Off-ſets as following:

Firſt, On the Line AB,

			Feet.				Feet.
Make	A *b*	equal to	17	and the Off-ſet	*b* 9	equal to	18
	A *a*		20		*a* 1		15
	A *c*		35		*c* 10		14
	A *x*		48		*x* 2		8
	A *d*		67		*d* 11		36
	A *h*		93		*e* 3		26

Secondly,

Secondly, On the Line BD,

$$\text{Make}\left\{\begin{matrix} Bf \\ Bw \\ Bi \\ Bk \\ Bn \end{matrix}\right\}\text{equal to}\overset{\textit{Feet.}}{\left\{\begin{matrix} 28 \\ 45 \\ 48 \\ 62 \\ 88 \end{matrix}\right\}}\text{ and the Off-fet }\left\{\begin{matrix} f\ 4 \\ w\ 5 \\ i\ 12 \\ k\ 6 \\ n\ 13 \end{matrix}\right\}\text{equal to}\overset{\textit{Feet.}}{\left\{\begin{matrix} 31 \\ 14 \\ 42 \\ 15 \\ 28 \end{matrix}\right\}}$$

Thirdly, On the Line DE,

$$\text{Make}\left\{\begin{matrix} Do \\ Dp \\ Dh \end{matrix}\right\}\text{equal to}\overset{\textit{Feet.}}{\left\{\begin{matrix} 2 \\ 51 \\ 60 \end{matrix}\right\}}\text{ and the Cff-fet }\left\{\begin{matrix} o\ 14 \\ p\ 7 \\ h\ 15 \end{matrix}\right\}\text{equal to}\overset{\textit{Feet.}}{\left\{\begin{matrix} 10 \\ 20 \\ 15 \end{matrix}\right\}}$$

Fourthly, On the Line EF,

$$\text{Make}\left\{\begin{matrix} Er \\ Et \end{matrix}\right\}\text{equal to}\overset{\textit{Feet.}}{\left\{\begin{matrix} 5 \\ 36 \end{matrix}\right\}}\text{ and the Off-fet }\left\{\begin{matrix} r\ y \\ t\ 8 \end{matrix}\right\}\text{equal to}\overset{\textit{Feet.}}{\left\{\begin{matrix} 21 \\ 21 \end{matrix}\right\}}$$

Laftly, Set 11 Feet back from F to v, and on the Line Fv make the two Triangles wvx, and Fvx; fo that

$$\text{The Sides}\left\{\begin{matrix} w\ v \\ w\ F \\ F\ x \\ v\ x \end{matrix}\right\}\text{be equal to}\left\{\begin{matrix} 21 \\ 18 \\ 15 \\ 17 \end{matrix}\right\}\textit{Feet;}$$

And then right Lines being drawn from the Extremes of the feveral Off-fets, will complete the Plan, as required.

Now is to be obferved, That this Plan, which confifts of 19 Angles, is truly plan'd by taking of three Angles only, *viz.* thofe at B, D, and E; and therefore for Open Enclofures, that are not hilly or mountainous, I recommend this Method for the very beft that has been yet publifhed or practifed by any.

PROBLEM VII. Fig. CXXXII.

The Plan of a Piece of Land, confifting of many Sides, whofe Angles are inacceffible by Bufhes, Wood, &c. *fo that we cannot by any Means meafure therein, to take their feveral Quantities; as* a, b, c, d, e, f, g, h, i, *being given, to find the Quantity of each within the Bounds thereof.*

PRACTICE *in the Field. Firft,* Begin at any Side thereof, fuppofe fg, and from any two Points therein, as at k and n, meafure off, at Right Angles, two equal Diftances, as mk and ln, each 15 Feet; and through their Ends ml, range a Line at Pleafure, as op. *Secondly,* In the fame Manner, from two Points taken in the Side gh, (the farther from each other the better,) as at qw, meafure off, at Right Angles, to each the fame Length, fo that a Line paffing through their Extremes, will pafs freely by the Bufhes, *&c.* Suppofe each to be 13 Feet; then a right Line being ftrain'd, fo as to pafs through

the Ends thereof, will cut the Line *op* in *s*, and the Angle *osv* will be equal to the Angle *fgn*. In the like Manner, equal Distances being set off from the Side *hi*, as *yz*, 1, 3, at the Points *z*3; and the right Line *y*2 being strain'd to pass through the Points *y*, 1, it will cut the Line *rx* in *x*, and the Angle *rx*2 will be equal to the Angle *ghi*: And so in like manner all the remaining Angles may be found, as required. And if we are required to make a Plan of the same also, then we must proceed as following:

First, HAVING ranged Lines parallel unto every Side of the Field, as aforesaid, for thereby to discover the Quantity of each Angle, as the Lines 29, 30; 30, 17; 17, 12; 12, 8; 8, 4; 4*x*; *xs*; *s* 31; and 31, 29.

Secondly, Make an Eye-Draught, expressing every Side, and every Angle thereof; also the parallel Off-sets to each Side.

Thirdly, Measure every Side, and every parallel Off-set from each Side, and place down their several Measures on their respective Lines; also take the Measure of every Angle, as before has been taught, which also place down accordingly.

Fourthly, On Paper draw a right Line at Pleasure, as 29, 31; and therein assume a Point as at 29, and from thence draw the right Line 29, 30, making an Angle equal to the Angle there measured, and make the Length of the Line 29, 30, equal to the Length measured on the Ground, as expressed in the Eye-Draught.

Fifthly, Make the parallel Off-sets 22, 24; 21, 30; also 25, 26; and 27, 28; each equal to their respective Lengths measured; and through the Points 25, 27, draw the Line *af*; and through the Points 22, 21, draw the Line *ab*, both at Pleasure; and then will the Angle *fab* be equal to the Angle 31, 29, 30.

Sixthly, Make the Line 29, 31, equal to the measured Length expressed in the Eye-Draught, and at the Point 31, make the Agle 29, 31, *p*, equal to the Angle measured, and draw 31 *p*, at Pleasure.

Seventhly, From any two Points in the Line 31 *p*, set off the two parallel Off-sets, which make equal to their measured Lengths, and through their Extremes *k* and *n*, draw the Line *fg*, which will cut *af* in *f*; and then will *af* be the true Length of that Side, and the Angle *afg* will be equal to the 29, 31, *p*. Proceed in like Manner to lay down every other Side, Angle, and parallel Off-sets; and then right Lines being drawn through their respective Extremes, will interfect each other, and form all the remaining Sides and Angles, as required; and as truly, as if you had free Access to measure into every Angle without Obstruction.

Note, If when the several parallel Lines for determining the Angles had been ranged, you had from any one of those Angles (as from the Angle 5) ranged out a right Line at Pleasure, as A 5, for a Stationary Line, and from thence taken Off-sets into every new Angle, as has been already taught in the last Problem, and expressed the same in your Eye Draught, you would very readily from thence have laid down the same by your Scale, with the parallel Off-sets also; through which, Lines being drawn, would have expressed the Plan of the Whole, as required.

PROBLEM

PROBLEM IX. Fig. CXXXIII.

To take the Plan of an irregular Piece of Land, in the Midſt whereof there is a Pond of Water, which prevents the foregoing Methods from being put in Practice, as a b c d e f g h i k l m n o p.

PRACTICE *in the Field.* *Firſt,* Make an Eye-Draught thereof, and therein draw right Lines from Angle to Angle, (as few as may be,) as in the Figure. *Secondly,* Meaſure every Line and Off-ſet; whoſe Meaſures place on the reſpective Lines; and take ſo many Angles thereof as are neceſſary, which herein are the Angles at *b, c, d, h, l,* and *m;* after which you may delineate the Plan thereof, as following:

PRACTICE *on the Paper.* *Firſt,* Draw a right Line to repreſent *b m,* which make equal to 110 Feet, the meaſured Length; and at 21 Feet, 51 Feet, and 74 Feet from *m,* ſet off the Off-ſets A *n* 11 Feet 6 Inches; C *o* 4 Feet, B *p* 18 Feet: Alſo, on *b* lay down the Angle *a b m,* with a Radius of 10 Feet, and Chord Line of 13 Feet 6 Inches, and make *a b* equal to 18 Feet. *Secondly,* Draw the Lines *a p, p o, o n,* and *n m;* and make the Angle *c b m* equal to the Meaſures taken, that is, with the Radius of 20 Feet ſet off a Chord Line of 13 Feet, as expreſſed in the Eye-Draught, and make *b c* equal to 37 Feet 6 Inches. *Thirdly,* On *c,* with the Radius of 10 Feet, ſet from the Line *b c* the Chord Line of 12 Feet, as unto *x;* and draw *x c* out at Pleaſure unto *d,* making *c d* equal unto 21 Feet. *Fourthly,* On *d,* with the Radius of 16 Feet, ſet from the Line *c d* the Chord Line 27 Feet, as unto F; and from *d,* through F, draw the right Line *d g,* which make equal to 72 Feet, and thereon, at 5 Feet, and 41 Feet Diſtance from *g,* as at the Points 5 and G, ſet off the Off-ſets 5 *f* equal to 5 Feet, and G *e* equal to 17 Feet; and then draw the Sides *d e, e f,* and *f g.* *Fifthly,* Continue *d g* unto *h,* making *g h* equal to 32 Feet; and on *h,* with the Radius of 18 Feet, from the Line *g h,* ſet off the Chord Line 25 Feet 6 Inches, as unto H; and draw *h* H out at Pleaſure, as unto *l,* making *h l* equal unto 76 Feet, and thereon, at 13 Feet, and 51 Feet 6 Inches, as at the Points *z* and I, ſet off the Off-ſets *z i* and I *k,* making *z i* equal to 13 Feet 6 Inches, and I *k* equal to 18 Feet; and draw the Lines *h i, i k,* and *k l.* *Laſtly,* Join *m l,* which will complete the Plan, whoſe Length (if the Work be truly taken, and truly laid down,) will be found to contain 55 Feet, and the Chord Line of the Angle *m l h,* with the Radius of 17 Feet 6 Inches, will be equal to 26 Feet, as exhibited in the Eye-Draught.

PROBLEM X. Fig. CXXXIV.

To take the Plan of an irregular Piece of Water ſituated within an irregular Field.

PRACTICE. *Firſt,* Make an Eye-Draught, and meaſure all the Sides and Angles thereof, as by the laſt Problem, making your Stations as few as poſſible; ſuppoſe at the Points 10, 14, 17, A, 6, 7, and 8; and draw the Lines 14, 10; 10, 8; 14, 17; 17 A; A 6; 6, 7; and 7, 8 : From all which take the proper Off-ſets unto the Edge of the Water, as alſo from the Sides of the Field; which delineate, as before taught in Problem IV. hereof, and you will complete the Plan, as required.

PROBLEM

PROBLEM XI. Fig. CXXXIV.

To take the Plan of an irregular Piece of Land, by going about the ſame Without-ſide, in a Lane; and to deſcribe the Lane alſo.

PRACTICE. *Firſt*, Make an Eye-Draught by going about the ſame, as alſo of the Sides of the Lane, as they happen; and then begin at any one Angle thereof, ſuppoſe at the Angle 14, and meaſure the Side 14. 13 to be 48 Feet. *Secondly*, To take the Angle 14 13, 12, continue on the Side 13. 12 towards 47, and make 13. 47, and 13. 48, each equal to 10 Feet, and meaſure the Chord Line 47. 48 Feet: Proceedin like Manner to meaſure all the other Sides and Angles, whoſe Quantities note down in your Eye-Draught, and afterwards delineate them, as taught in the foregoing Problems.

NOTE, If, as you go round the Field, you take the proper Off-ſets from the Side thereof, into every of the Angles of the Lane, as are expreſſed in the Figure, you may truly delineate the Sides thereof alſo, and compleat the Whole, as required.

PROBLEM XI. Fig. CXXXV.

To make the Plan of a Serpentine River, Brook, &c.

PRACTICE. *Firſt*, Make an Eye-Draught, and aſſign proper Stations along the Side of the River, as at *a, b, c, d, e, f, g, h, i, k, l, m*. *Secondly*, Beginning at *a*, meaſure to *b*, and as you go forward, take the proper Off-ſets from the Line *a b* unto the Edge of the Water, whoſe Diſtances from *a*, and Lengths from the ſtationary Line unto the Water, be careful to place down truly in your Eye Draught. *Secondly*, Meaſure in like Manner from *b* to *c*, and note down the ſame; alſo meaſure back from *c* to *a*, and then you have the three Sides *a b, b, c*, and *c, a*, which forming the Triangle *a b c*, is delineated by *Prob.* II. *Lect.* IV. hereof, and truly forms the Angle *a b c*. *Thirdly*, Meaſure from *c* to *d*, alſo from *d* to *a*, and on *a c* compleat the Triangle *a c d*, obſerving, as you meaſure the Side *c d*, to take the proper Off-ſets therefrom unto the Water's Edge. *Fourthly*, Continue *c d* to *m*, and take the Angle *m d n*; alſo meaſure the Line *d e*, and take the proper Off-ſets from the ſame. *Fifthly*, Repeat the like Operation, at every of the other Angles, as you ſee expreſly in the Figure, and your Eye-Draught will be compleated. After which, make your Plan therefrom, by laying down the ſtationary Lines with their Angles and Off-ſets, as before taught in the foregoing Examples, and you will compleat the Whole, ts required.

PROBLEM XIII. Fig. CXXXVI. Plate X.

To make a Plan of any Town, City, *&c.*

THE Figure preſented, for this Example, is an imaginary Part of the *City of London*, began at *Aldgate*, and continu'd unto the *Royal Exchange*.

PRACTICE. *Firſt*, Range a right Line, as far as can be, through the principal Street, as A B, from *Aldgate* to *Leadenhall Street* and *Cornhill*; from which take Off-ſets, unto the ſeveral Angles of each Street, which come into the ſame on the Right and Left-hand Sides, as from *d* to *k*, from *p* to *o*, from *r*

to

to *t*, from *s* to 2, from *x* to *y*, from *w* to *z*; from 1 to 6, from 5 to *z*, from 8 to 7, from 12 to 64, from 13 to 14, from 18 to 17, from 19 to 20, from 22 to 23, from 25 to 26, from 29 to 28, from 32 to 33, from 35 to 65, from 36 to 37, from 40 to 41, and to 39, from 44 to 45, from 46 to 66, from 48 to 50, from 51 to 52, from 53 to 67, from 56 to 68, from 57 to 58, from 60 to 61, from A to 63, and 62; obferving, as you go forward, to meafure and fet down on your Eye-Draught the feveral Diftances between the Off-fets; and then will you have taken the true Dimenfions of *Cornhill*, and *Leadenhall-ftreet*; together with the Enterances in *Exchange-Alley*, *Royal-Exchange*, *Swithin's-Alley*, *Birchin-Lane*, *Finch-Lane*, *Grace-church-Street*, *Bifhopfgate-ftreet*, into *Leadenhall-Market*, *Lyme-Street*, *St. Mary-Axe*, *Biliter-Lane*, *Greyhound-Alley*, *Fenchurch-ftreet*, *Crouchet-Friars*, and *Duke's-Place.* This done, draw a Line at Pleafure, and make it equal to the meafured Diftance from A unto B, and thereon fet off from your Scale of Feet the feveral Diftances of the Off-fets, and the Length of every Off-fet alfo; and draw the feveral Lines from one Off fet unto the other, which will form the Sides of *Cornhill* and *Leadenhall-Street*. *Secondly*, Begin with the next principal Street that comes into the laft taken, as *Bifhopfgate-Street*; and in the Line AB, as at the Point 31, affign a ftationary Point; as alfo another at the upper End of *Bifhopfgate-Street*, as at D, at which Place erect a Station-Staff. *Thirdly*, Sight in another Station-Staff at 30, between the Points 31 and D, at 10 or 20 Feet from the Point 31; alfo fet the fame Diftance from 31 to 27, and meafure the Chord Line 27, 30, the Quantity of the Angle, which note down on your Eye-Draught. This done, meafure from 31 towards D, and take the Off-fets to each Side at the Angles of the Streets coming into the fame, as at 64, the Off-fet to 65 the End of *Threadneedle-Street*; alfo at 69 and 73, the Enterance into *Crosby-Square*; alfo at 75 and 76, the Enterance of the Paffage out of *Bifhopfgate-Street* into *Broad-Sitreet*; alfo at 79 and 80, the Enterance into *Great St. Helens*. All which being plan'd according to their refpective Diftances and Lengths, and Lines being drawn from one Off-fet unto the other, will form the feveral Sides of *Bifhopfgate-Street.* In the fame Manner proceed with all the other Streets from one to the other, obferving to plan every Street fo foon as your Eye-Draught thereof is completed, before you take the next. In fhort, this Method is fo very plain and intelligible, by the Lines drawn in the feveral Streets of the Plan, that it will be but Tautology to fay any more hereof.

PROBLEM XIV. Fig. CXXXVII. Plate XI.

To take the Plan of a Vault, or Cellar, that is groined over, as b a d c.

PRACTICE. *Firft*, Make an Eye-Draught thereof, expreffing the Thicknefs of the Out-Walls, and Projection of the Pillafters againft the Sides, and in the Angles thereof, as at F C B A, E I, *m* F, G H; alfo the Piers at K and L. This done; meafure the true Length of every particular Side and Part thereof, and place them to their refpective Parts in your Eye-Draught.

It will be alfo neceffary to take one of the Angles in a Plan of four Sides, as this Example; becaufe fome Buildings are not truly fquare, or right-angled; and when fuch Buildings happen, and you fuppofe them to be fquare or right-angled, and make the Plan accordingly, it will be falfe: Therefore, to be always fure of the Truth, take one Angle; and that being truly laid down, with the Sides proportion'd thereunto, the Plan cannot but be truly defcribed, in Manner as following.

PRACTICE II. *To draw the Geometrical Plan.*

First, Make a Scale of Feet of ſuch a Size as will beſt ſuit your Purpoſe. *Secondly*, Draw a right Line, as *dc*, which make equal to 45 Feet; and on the Ends *d* and *c*, erect the Perpendiculars *db* and *ca* each equal to 28 Feet, the Dimenſions noted on the Eye-Draught, and draw *ba*, which will be alſo equal to 45 Feet; becauſe 'tis parallel unto *dc*, and the Angles at *a* and *b* are equal to the Angles at *c* and *d*, and conſequently *badc* is a Parallelogram. *Thirdly*, The Thickneſs of the Wall being three Feet, as ſignified by the Dimenſion between *gn*, therefore at three Feet, within the Out-Line *badc*, draw Lines parallel thereto, as AD, D*p*, *oy*, and 1 H, which will repreſent the Thickneſs of the Foundation. *Fourthly*, Becauſe the Enterance is in the Middle of *dc*, therefore divide *dc* into two equal Parts; and becauſe the Breadth of the ſaid Enterance is 4 Feet 10 Inches, therefore make *hg hf*, each equal to 2 Feet 5 Inches, and draw *fe* and *gn* parallel unto *ac*; and then will you have expreſſed the Enterance in its true Situation. *Fifthly*, Since that the Pillaſters have all the ſame Projection from the Wall, *viz.* each 9 Inches, as ſignified at the Pillaſter I, therefore at 9 Inches, within the Lines DA, D*p*, 1 H, *o* H, draw Lines parallel thereto, as 13, 2, 13 *m*, *py*, and 2 *z*; which limits the Projections of all the Pillaſters againſt the Sides at CBEI, FG, and forms thoſe in the Angles at DA*o*H. *Sixthly*, Becauſe the Diſtance of the Pillaſter B is 10 Feet 2 Inches from A, therefore ſet 10 Feet 2 Inches from A to 5; alſo from 2 to 7, and draw the Line 5, 7, the Side of the Pillaſter. Again, becauſe the Breadth of the Pillaſter is 3 Feet, as ſignified in the Eye-Draught at B, therefore ſet 3 Feet from 5 to 6, alſo from 7 to 8, and draw the Line 6, 8, and ſo will you truly have repreſented the Pillaſter B in its true Situation. Proceed in like manner to ſet off the Diſtance of the next Pillaſter C from B, according to its Dimenſions found, which is 10 Feet 4 Inches, and Pillaſter 3 Feet, as before; and ſo in like Manner all the Remainers at E, F, G, I. *Seventhly*, When all your Pillaſters are truly placed, draw right Lines from the Sides of every one unto its oppoſite, as the Lines 7, 25; 8, 33; alſo 9, 2 *z*; 12, 22; and likewiſe 15, 27; 17, 30; which will interſect each other in the Points 24, 23, 26, 25, and 20, 19, 22, 2 *z*; and form the Baſis of the Piers at L and K. *Laſtly*, If right Lines be drawn from the Angle of every Pillaſter and Pier unto its direct oppoſite, as from 2 to 23, 7 to 27, 8 to 19, 9 to 24, *&c.* they will repreſent the Baſis of the ſeveral Groins of the Arches, over which they ſtand perpendicularly, and complete the Plan as required.

Note, When the Lines of your Plan are drawn, fill up the ſolid Parts thereof with a faint Waſh of *Indian* Ink, to diſtinguiſh the ſolid from the open Parts of the Whole.

PROBLEM XV. Fig. CXXXVIII. Plate XI.

To take the Plan of the Ground-Floor of a Dwelling-House, as badc.

PRACTICE. *Firſt*, Make an Eye-Draught thereof on a Piece of waſte Paper, and therein repreſent the Out-Walls, with the Windows and Doors, diſtinguiſhing each from the ſolid Brick-work; by making the ſolid Parts black with your Black-Lead Pencil, and leaving the Doors and Windows white.

THE

The Doors must also be distinguished from the Windows, by their Sides being drawn parallel to each other, as *lmon*; and the Windows, with their Sides from the Window-Frames, to fall back or open themselves immediately into the Rooms, so as to admit of the Light's passing freely therein, as the Sides 4, 6, and 5, 9, of the Window 2, 3, 6, 9; which is called the *Skew-Back*; so the Skew-Backs of the aforesaid Windws are the Distances 7, 6, and 8, 9, being so much back from the Sides of the Frame, if the same had been continued in right Lines from 4 to 7, and from 5 to 8. The Quantity of the Angle necessary for the Skew Backs of Windows, will be declared in the Lecture on the Kinds and Proportions of Windows.

When in your Eye-Draught you have represented the several Windows and Doors, then proceed to divide the Inside thereof into its several Parts. By Partitions, Walls, *&c.* expressing the Doors, or Enterances of each Room in their proper Places; as also the Chimneys, Closets, *&c.* Together with the Stair-Case, or Stair-Cases, when more than one is in a House: Also the Portico *dc*, 39, 33; with the Plans of the Base of each Column, as they appear unto your Eye. It's not material whether your Eye-Draught be truly like unto the Building, whose Plan you are to make; for was you to make the Plan of a Building that was truly square, that is, every of its Sides equal, and the Sides of your Eye-Draught were each unequal, it doth not avail any Thing, provided that to each Side you place the just Dimension or Measure thereof, from whence you lay down in your Plan the Length of each with Exactness. Therefore observe, That in your Eye-Draught, if you do but express every Part with its true Dimension, and be careful not to confuse your Dimensions together, you may with great Pleasure delineate your Plan, as required, in manner following.

Practice. Your Eye-Draught being made, and all the several Dimensions taken, and placed to their respective Parts; proceed to draw the Geometrical Plan, as follows:

(1.) Having made a Scale of Feet proper for the Size of your Plan, draw a right Line *dc* equal to 45 Feet 6 Inches; and on the Points *dc* erect the Perpendiculars *ca* and *db*, and make each equal to 45 Feet 6 Inches, the Dimensions taken and expressed in your Eye-Draught, and draw *ab*; then will *badc* be the Out-Line of your Plan.

			Feet.	*Inch.*	
(2.) Make	1 2	equal to	7	8	and then you will have divided out the Breadth of the two Windows 11, 10; and 3, 2, with the Door 1 *t* also.
	2, 3		5	7	
	3, 1		6	8	
	1 *t*		5	6	
	t 10		6	8	
	10, 11		5	7	
	11 *b*		7	8	

(3.) The Thickness of the Out-Walls being 3 Feet and 4 Inches, as expressed at the Door 1 *t*, between 1 *y*; therefore at the Distance of 3 Feet and 4 Inches within the Out-Lines, draw the right Lines *fe*, *fh*, *hg*, and *eg*, which determines the Thickness of the Out-walls. (4.) From the Points 2, 3; 1 *t*; 10, 11, draw the right Lines 2, 7; 3, 8; 1 *y*; *tv*; 10, 15; 11, 13; perpendicular to *ba*, and parallel to *bd*; which will determine the Front of each Window, and Breadth of the Door. *Fifthly*, Since the inward Face of the

Window-Frames

c

Window-Frames ſtands 1 Foot and 2 Inches inwards from the Face of the Front, therefore make 2, 4; 3, 5; 10, 12; and 11, 13; each equal unto 1 Foot and 2 Inches; and draw the Lines 13, 12; and 4, 5; repreſenting the ſame. *Sixthly*, Becauſe the Skew-Backs 9, 8; 7, 6; are each equal to 1 Foot 2 Inches; therefore ſet 1 Foot 2 Inches from 7, and from 8 to 9; and draw the Lines 4, 6; 5, 9; which are the Shew-Backs to the Window 3, 2, 5, 4. Proceed to finiſh in like Manner all the other Windows and Doors, according to their ſeveral Dimenſions, and then begin with the internal Parts, follows:

Firſt, Biſect the Breadth of each Door in the Points *r* and *k*, and draw the right Line *rk* through the Middle of the Plan. *Secondly*, Becauſe that the Breadth of the Paſſage *pq* is 8 Feet and 6 Inches, therefore draw *zq* and *xp* each at the parallel Diſtance of half *pq*, *viz.* 4 Feet and 3 Inches, making *px* equal to 21 Feet. *Thirdly*, Since that the Partition-Wall A*zq*G is 9 Inches in Thickneſs, therefore draw AG at the parallel Diſtance of 9 Inches from *zq*. In like manner draw the other Partition-Wall *xp*, and in both expreſs the Doors at PQ, (which the Engraver by miſtake has filled up.) RS, and TV, according to their reſpective Dimenſions. *Fourthly*, Make GE equal to 17 Feet and 6 Inches; and at E erect the Perpendicular E*x* equal to 8 Feet 11 Inches. Alſo make *g*F equal to 11 Feet 6 Inches, and draw F*x*, in which ſet off the Dimenſions of the Chimney, and then that Room is completed. *Fifthly*, Make AD equal to 17 Feet and 3 Inches, and on D erect the Perpendicular CD equal to 8 Feet 9 Inches; alſo make *e*B equal to 11 Feet 6 Inches, and join BC, in which ſet off the Chimney according to its Dimenſions, and ſo will that Room be completed alſo. *Sixthly*, Divide CD and *x*E, each in the Middle by the Partition, as in the Plan, and thereby each Room is accommodated with a convenient Cloſet as X and W. *Seventhly*, In the ſame Manner, complete the other Room IH, according to the reſpective Dimenſions taken. *Eighthly*, Draw *x*24 parallel to *k*H, which completes the ſolid Back of the Chimney. *Ninthly*, As the Stair-Caſe *wf*, *x*24, is the next in Order, therefore draw the right Lines 22; 18, parallel to *wf*, 0, 21, parallel to 24*x*; and *a*25, parallel to *f*24, each at 7 Feet Diſtance, as expreſſed by the Dimenſions. *Tenthly*, Divide *wa*, 18, 19, each into as many equal Parts as there are Steps contain'd, (which here is ſuppoſed to be but 5,) and draw right Lines through each Diviſion to repreſent the Steps. In the ſame manner divide the Lines 21, 20, and 25*x*, and draw them Steps alſo. *Eleventhly*, On the Points 19 and 20, with any Opening of your Compaſſes, deſcribe two Quadrants, and divide the Arches into 4 Parts, when the Stairs are not very large, or into 5, or more Parts, when they are large, as in this Example; and through the Diviſions thereof draw the ſeveral winding Steps, as exhibited in your Eye-Draught. *Twelfthly*, Divide 19, 20, and 22, 0, in *cc*, and draw the Line *cc*; which will complete the Stair Caſe. *Thirteenthly*, Continue on the Sides *bd* to 39, and *ac* to 33, making *d*37, and *c*32, each equal to 6 Feet; alſo make 37 39, and 32 33, each equal to 3 Feet and 3 Inches, and draw the right Lines 37 32, and 39 33. *Fourteenthly*, Becauſe that the Diſtance between the two middle Coloumns is 9 Feet, therefore ſet 4 Feet and a half from A to 41, and from A to 44; and draw 41, 43, and 44, 46, each perpendicular to the Line 32, 37. *Laſtly*, Make 32, 34; 33, 35; 41, 40; 43, 42; 44, 45; 46, 47; 37, 36; and 39, 38; each equal to 3 Feet and 3 Inches; and draw the Lines 34, 35; 40, 42; 45, 47; and 36, 38;

they

they will complete the Plan of the Portico *c, d,* 33, 39; and then filling up the ſeveral ſolid Parts with *Indian* Ink, not too black, which looks rather too hard for the Eye, the Whole will be completed, as required.

Note, As this Figure is only laid down for Example ſake, the Proportion of its Parts has not been conſidered or regarded, that being the Work of the Sixth Part.

THESE Problems being well underſtood, there can no Difficulty ariſe in taking and delineating the Plan of any Building whatſoever: Therefore I ſhall conclude this Part of the *Lecture* with Plate XII. which I have given for Practice, and wherein the Whole is ſeen at firſt View, by the ſeveral Lines that conſtruct the ſame.

THE next Part of this *Lecture,* is the Manner of delineating the Geometrical Elevation of Buildings in general, wherein will be comprized every Thing that is uſeful and curious, and which herein will be more extenſively handled than has been yet done by all the Authors who have wrote on the Architectural Art. For as Geometrical Elevations conſiſt of Windows, Doors, and Intervals of Wood, Brick, or Stone, which are oftentimes enrich'd with Columns, Pilaſters, Cornices, Entablatures, Ruſticks, Key-Stones, and divers other Embelliſhments; I am therefore under a Neceſſity in this Place, to explain and teach their various Conſtructions and Proportions, before I make any further Advance to the delineating Geometrical Elevations: For unleſs the Manner of Drawing the Orders be well underſtood, 'tis impoſſible to delineate the Geometrical Elevation of Buildings, wherein any one or more Orders are introduced.

AND whereas, ſince the Time of the antient Architects, many Methods and Rules for proportioning and drawing the *Orders* have been invented by many Architects; in Conſideration thereof, and of the various Opinions of People, who ſo differ among themſelves, that every Architect has his Admirer, I ſhall therefore, in hopes of giving a general Satisfaction, preſent the World with all the various Methods and Proportions that have hitherto been practiſed; wherein, as I proceed, ſhall give ſome general Remarks and Obſervations on the Whole.

BEFORE I proceed to this moſt curious, and moſt delightful Subject, I muſt advertiſe my Reader, *Firſt,* That the Conſtruction of the five Orders of Architecture, in this Geometrical Part, is, as before has been obſerved, abſolutely neceſſary, as being the Buſineſs of Geometry to teach, and which muſt be firſt well underſtood, before we arrive unto the ſixth Part hereof, which will conſiſt only of the Manner of applying the *Orders* to various Uſes in the Formation of Deſigns for Buildings in general. *Secondly,* That after the five *Orders* have been herein univerſally illuſtrated, I will then alſo illuſtrate the Proportions of Doors, Windows, Chimney-Pieces, and Niches by one general Rule; by which all Kinds will be as eaſily performed; as to delineate the *Tuſcan* Baſe, when the Meaſures of the Heights and Projections of its Members are given. And whereas Mr. GIBBS has, contrary to the Uſe of Workmen, given a very great Variety of good Deſigns for Doors, Windows, and Chimney Pieces, without their Meaſures being affix'd thereto, I ſhall, in Honour to that ingenious Gentleman, and with an affectionate Reſpect to Workmen in general, comprize all thoſe his ſeveral Deſigns, with general Meaſures affix'd to each: By Help of which, every Workman will be enabled to execute them moſt readily, to any Size required, having the Breadth of a Door, Window, Chimney, or Nich only given. To

these will be prefix'd the Designs of *Doors*, *Windows*, and *Chimney-Pieces* by INIGO JONES, in like manner; as likewise of all other Architects that are worth the Regard or Notice of Workmen.

WHEN that I shall have thus illustrated the Proportions of those Ornaments which enrich the several Fronts of Buildings in general, I shall then proceed to shew Geometrical Rules entirely new, perfectly easy, and more useful than has been yet published, for framing all manner of regular and irregular Roofs, and twisted Rails to Stair-Cases; which will conclude the *Geometrical Architecture* of this *Lecture* on the various Constructions of Plans, and Geometrical Elevations of Buildings, in general. The Residue of this Geometrical Part will consist of Lectures on the following Subjects, *viz.*

ON the Proportion of a Circle, and its Parts; on the Ratio, Reduction, Transformation, and Equality of Geometrical Figures; on the Division of Lands; on the Power of Lines, wherein the Reason of Mensuration is clearly demonstrated; on the Division and Proportion of Lines, wherein the Extractions of the square and cube Roots are demonstrated; on Arithmetick geometrically performed, in a very easy Manner by Lines only, to greater Exactness than can be done by Figures; on Fractions proper and improper; on Decimal and Duodecimal Arithmetick; on the Generation of Solids; on the Mensuration of the Superficies and Solidities of solid Bodies; and lastly, on the various Sections of circular and elliptical Cylinders and Cones. All which will be most concisely, fully, and familiarly handled, to the Understanding of the meanest Capacity, and both advantageous and delightful to every Lover of Architecture. Now to the Purpose; wherein I desire, that every one will consider every Paragraph without Prejudice or Conceit, and not make any Objections, except that he can prove them to be just.

☞ As the Antients well understood the beautiful Proportions of the Orders, I shall therefore introduce each Order, with their Methods of describing the Five Orders of Architecture geometrically, without any Respect or Regard being had to Models, Minutes, or Parts, as invented by latter Architects. And although the *Doric* was the first Order of the *Greeks*, who invented it a long Time before the *Tuscan* Order was invented by the *Latins*; yet as the *Tuscan* is the most massy, strong, and robust, and Custom has prevailed to place it before the *Doric*, so I shall also place it at the Head of this Discourse, in the Manner as following:

I. *Of the* TUSCAN ORDER *of the Antients.*

To whom, of the *antient Architects*, the Honour is due, for the geometrical Rules of dividing and proportioning the Five Orders of Columns in Architecture, I believe to be unknown, since that neither *Vitruvius*, *Palladio*, *Scamozzi*, or *Vignola*, has taken any Notice thereof, although the Proportions of the Orders of *Vignola* are nearly the same, as may be seen by comparing them together. But however, as I am possessed of their valuable Rules, which are both delightful and useful, I shall therefore communicate them for the Publick Good, in Manner following:

BUT before I enter upon the Orders of Architecture in particular, I think it is very reasonable, that I should in the first Place explain them in general; and afterwards dissect them separately in their Turns. And as I am certain all the Eyes of Mankind are on me, to behold the Direction of

this

this Part, I ſhall therefore, without Favour or Affection to any, diſplay the Beauties and Imperfections of thoſe Authors, who are the Subject of this Diſcourſe.

Of an ORDER, *and its Parts.*

AN entire Order of Architecture, be it *Tuſcan, Doric, Ionic, Corinthian,* or *Compoſite*, conſiſts of three principal Parts: As G H I, Plate XIX, *viz.* I the Pedeſtal, H the Column, and G the Entablature; which are ſeverally divided into three principal Parts alſo, as in Plate XXI. where the Pedeſtal V N W is divided into its Baſe W, its Die or Cube N, and its Cornice or Capital V. The Column R S T into its Baſe T, its Shaft or Fuſt, S and its Capital R: And the Etablature O P Q into its Architrave Q, its Frize, P, and its Cornice O: All which are compoſed of divers Parts, variouſly divided, called Members or Moldings, that are either right-lin'd or curved.

THE right-lin'd Members or Moldings are called Plinths; as *v* and B, Plate XX. or Fillet, as A; or Liſt, as S; or Abacus, as *k l*; or Architrave, as *i h*; or Frize, as *g*; or Corona, as *d*; or Plat-Band, as B, Plate XIX: Which in general differ in their Names, according to their Situations. The curved Moldings are of two Kinds, *viz.* Single and Compound; in each of which, there are two Varieties, *viz. Firſt,* In the ſingle curved Moldings, they are Convex, as the Ovolo E, Plate XVII. and Concave, as the Caveto G underneath it. And in the compound curved Moldings there are *Cima's*, or *Ogee's* of two Kinds; as B, Plate XVII. which is called *Cima Recta*, or the *Fore-Ogee*; and as *f*, Plate XX. which is called *Cimaſium*, or *Cima Reverſa*, or the *Back-Ogee.* And whereas the ſeveral right-lin'd Members are, in their Angles, truly ſquare; therefore from thence 'tis evident, that of Moldings, there be but three Kinds that are abſolute, that is to ſay, in common Terms, the *Square*, the *Hollow*, and the *Round*; and he who underſtands how to apply them well together, may juſtly be eſteem'd a good Judge of the Orders in Architecture.

BEFORE that we proceed to the Application of theſe Parts together, we ſhould conſider how to give Dimenſions to each, proper to the Uſes for which they are deſign'd; as that of being more or leſs ſtrong, and capable to ſuſtain a great Weight; or more or leſs capable of receiving thoſe Embelliſhments, that are requiſite for the Uſe, and agreeable to the Situation of the Building.

THE Proportions of Columns have their Differences in their Heights, as being higher or lower, and of equal Diameters. Thus to the *Tuſcan* Column, *Palladio* gives ſeven Diameters;

To the	*Doric*	Column	8	Diameters.
	Ionic		9	
	Corinthian		10	
	Compoſite		10	

And, as *Perrault* obſerves, the Form of their particular Members, proper to their Proportion, takes its Differences from the Plainneſs or Richneſs of the Ornaments of their ſeveral Parts.

IT was from hence, that the three Orders of the *Antients*, namely, the *Doric, Ionic,* and *Corinthian*, were conſider'd: For we find that the *Doric*, which is the ſhorteſt of the three, and the moſt maſſy, has in all its Parts a plain, but noble

noble Aſpect; although its Capital has neither Volutes, nor Leaves. And on the contrary, the *Corinthian*, which of the three is the higheſt, has in its Capital, Enrichments of Leaves, and Volutes, with Modillions in its Cornice, adorn'd with Leaves alſo; which, with its fluted Column, *&c.* render it a delicate and rich Order. And herein conſiſted the Extreams of the Antients; who, for a Mean between both, inſtituted the *Ionic*, whoſe Capital has no Leaves; and its Cornice only Dentils, inſtead of Modillions.

AFTER the Inſtitution of theſe three Orders, which the *Greeks* invented, the Moderns added two others; whoſe Proportions they have regulated to thoſe of the Antients, as having made one more groſs, plainer, and of leſs Altitude, than the *Doric*, which they call *Tuſcan*; and the other equally as rich, or, if I may be permitted to ſpeak, I think, much richer than the *Corinthian*, though of the ſame Altitude, whoſe Capital is compoſed or taken from thoſe of the *Ionic* and *Corinthian*.

THUS much with reſpect to the Orders in general, I ſhall now deſcend to

The General Proportion of the three principal Parts of entire Columns.

PROBLEM XVI. Plate XIII. Fig. XXX.

The Height of an entire ORDER *being given, to divide it into its principal Parts, viz. Into its* PEDESTAL, COLUMN, *and* ENTABLATURE, *as the Line* hn.

PRACTICE. *Firſt*, Draw a right Line at Pleaſure, as bf, and opening your Compaſſes to any ſmall Diſtance, as $f1$; ſet thereon 19 equal Diviſions, as at the Points 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19. This being done, on the Length $19f$ compleat the equilateral Triangle $a\,19f$, continuing the Side $a\,19$ towards w, and af, towards x, and making ab and an, each equal unto the given Height bn; then the Triangle abn will be equilateral alſo; and right Lines being drawn from a, through the ſeveral Points at 1, 2, 3, 4, 5, 6, 7, 8, *&c.* in the Line $19f$, will divide the given Height hn into 19 Parts alſo; of which, give 4 to mn, the Height of the Pedeſtal, three to hg, the Height of the Entablature, and 12 to gm, the Height of the Column.

Or otherwiſe,

LET hn be the the given Height as before.

PRACTICE. *Firſt*, Biſſect hn in i, and on the Point i, erect the Perpendicular ik, of any Length at Pleaſure. *Secondly*, Make the Angle ink equal to 30 Degrees, and draw nk, cutting ik in k. *Thirdly*, From k draw km, making an Angle of 45 Degrees with the perpendicular Line ik; then will mn be the Height of the Pedeſtal, and hm, the Height of the Column and Entablature, which divide into five equal Parts, by *Problem* XXII. of *Lect.* II. hereof, and giving the upper one to the Height of the Entablature, the remaining four will be for the Height of the Column.

Now ſeeing that the Entablature hg is one fifth Part of hm, it is alſo equal to one quarter of the Height of the Column. Upon ſome Occaſions, the Antients abated the Height of the Pedeſtal, making it equal unto one

one fourth Part of the Entablature and Column taken together; and therefore 'tis equal to one fifth Part of the Pedeſtal, Column, and Entablature, taken together; which, in my humble Opinion of the two Methods, is the moſt preferable, as being readily perform'd, by dividing the Height of the entire Order given into five equal Parts, of which the lowermoſt one is the Height of the Pedeſtal; and then the remaining four Parts being again divided

into { 5 } equal Parts, give the upper one to the	*Tuſcan* and *Doric,*	} Entablatures,
into { 6 } equal Parts, give the upper one to the	*Ionic, Corinthian,* and *Compoſite*	} Entablatures,

and then the	*Tuſcan*	Entablature will be equal to	$\frac{1}{4}$	of the Height of the Column, which is equal to	one	Diameter or Module, and	45 Minutes.
	Doric		$\frac{1}{4}$		two		00
	Ionic		$\frac{1}{5}$		one		48
	Corinthian		$\frac{1}{5}$		two		00
	Compoſite		$\frac{1}{5}$		two		00

THESE are the Proportions which the Antients practiſed, and *Palladio* obſerved, and which Mr. GIBBS recommends in his *New Rules for Drawing.* Folio 4.

HAVING thus eſtabliſhed the ancient Rules for dividing an entire Order into its Pedeſtal, Column, and Entablature, according to any Order, I ſhall in the next Place proceed to the Manner of dividing

The	Pedeſtals into their	Baſes, Dies, and Cornices, or Capitals.
	Columns into their	Baſes, Shafts, and Capitals.
	Entablatures into their	Architraves, Freezes, and Cornices.

Together with their ſeveral Members which compoſe the ſame. And,

I. *Of the general Proportions of the* Tuſcan *Order.*

PROBLEM XVII.

The Height of the Tuſcan *Pedeſtal being given, to divide the ſame into its Baſe, Die, and Cornice.*

Note, The Antients divided the Members of the principal Parts of their Orders after two different Manners, which I ſhall herein explain univerſally,

viz. { I. by Geometrical Lines.
{ II. by Equal Parts.

Plate XIII. Fig. CXXXI.

Let k y F *be the given Height.*

PRACTICE. *First*, Draw the Lines *a o*, L E, through the Ends or Points *k*, F, parallel to each other, and at right Angles unto the given Line. *Secondly*, Draw *a* F, whose Angle *a* F *k* be equal to thirty Degrees; and from F draw the right Line F *w*, making the Angle *k* F *w* equal to the Angle *a* F *k*; also from the Point *k*, draw *k w* perpendicular unto F *w*, and draw *a w* cutting *k* F in *m*. *Thirdly*, From *k* draw *k z* parallel unto *a f*, and from *m* let fall the Perpendicular *m l*. *Lastly*, Through the Point *l*, draw the right Line *g v*, which is the lower Part of the Capital or Cornice to the Pedestal; and then drawing the Line H 1 8 parallel unto L E, at the same Distance from L E as *g t* is from the upper Line *b o*, you will have divided the given Height into the Base, Die, and Cornice, as required.

Note, By this Rule the Ancients made the Height of the Base and of the Cornice equal, and which in some Cases might have an agreeable Effect; but I think far short of that Beauty which is seen in their other more general Method, which is to divide the given Height of the Pedestal into four equal Parts; of which give half of one Part to the Height of the Capital, and one whole Part, and one third Part thereof, unto the Height of the Base, as exhibited in Plate XXIV. This Manner of dividing the Height of the Cornice and Base is observed by Mr. GIBBS, and which is very reasonable should be so, since that as the Base is the Foundation and Support of all the rest, it should therefore consist of Strength superior to the Cornice, which is no more than a Covering to the Whole.

THE Base having one Part, and a Third, for its Height, is divided as following: To the Height of the Plinth one Part; and the one third Part remaining, being divided into six equal Parts, give one to each Fillet, above and below the Ogee, and the remaining four Parts is the Ogee.

THE Cornice being one half Part of a fourth Part, or an Eighth of the whole Height of the Pedestal, is divided into six equal Parts; of which, give one to the Fillet, two to the *Cima Reversa*, and the remaining three to the Platband. But more of this hereafter, when I shall speak of the Order in general.

PROBLEM XVIII. Plate XIII. Fig. CXXXI.

The Height of the Die of the Tuscan *Pedestal being given, to find its Diameter or Breadth geometrically.*

Let N M be the given Height.

PRACTICE. *First*, Bisect N M in *y*, and draw *x* 17 through the Point *y*, making the Angle *x y k* equal to 45 Degrees, and continue the Line H 18, until it meet the Line *x* 17 in the Point 17. *Secondly*, Bisect M 17 in the Point 15, from which let fall the Perpendicular 15 O on the Line *x* 17. *Thirdly*, Through the Point O draw the Line *n* D parallel unto *a y f*; also on the other Side, draw the Line *i* G at the same parallel Distance; and then *g t*, being drawn parallel unto H 18, the Line *b v*, or G D, will be the Diameter or Breadth of the Die, as required.

PROBLEM

PROBLEM XIX. Plate XIII. Fig. CXXXI.

The Height of the Base to the Tuscan *Pedestal being given, to divide it into the Fillet and Plinth.*

LET xD be the given Height.

PRACTICE. *First*, Make the Angle CDx equal to 30 Degrees, and draw the Line CD; which bisect in B, and from B raise the Perpendicular BA. *Secondly*, Bisect xA in the Point 16; then will x16 be the Height of the Fillet, and 16D the Height of the Plinth, as required.

Or otherwise, Divide xD, the given Height, into six equal Parts, and giving one to the *Fillet*, the remaining five shall be the Height of the Plinth, as required.

PROBLEM XX. Plate XIII. Fig. CXXXI.

The Height of the Base to the Tuscan *Pedestal being given, to find its Projection before the Upright of its Die geometrically.*

Let xD be the given Height.

PRACTICE. *First*, Make the Angle CDx equal to 30 Degrees, and draw CD, and bisect it in B; also raise the Perpendicular BA, as before done in the last Problem. *Secondly*, On D, with the Radius DA, describe the Arch AE; then will DE be the Projection of the Plinth, as required. *Thirdly*, The Base being before divided into its Fillet and Plinth, therefore from the Point E draw the Line E20 parallel unto 16D, and then bisecting 16, 20, in 19, the Point 19 will be the Projection of the Fillet. *Fourthly*, Continue the Height of the Fillet 19, 18, unto 11, making 18, 11, equal to x18; also make x14 equal to 11, 18; and on the Point 11, with the Radius 11, 10, describe the Hollow of the Die: And thus will you compleat the Projecture and Forms of the Members, to the Base, as required.

PROBLEM XXI Plate XIII. Fig. CXXXI.

To divide the the Height of the Cornice of the Tuscan *Pedestal into its* Cima-Reversa *and Fillet.*

Let $i\,h$ be the given Height.

PRACTICE. Make the Angle $b\,h\,i$ equal to 30 Degrees, and draw the Line $b\,h$, which bissect in e and on e, erect the Perpendicular $e\,f$; which will divide the given Height $i\,h$ in f; and then will $i\,f$ be the Height of the Fillet, and and $f\,h$ the Height of the *Cima Reversa*, as required.

PROBLEM XXII. Plate XIII. Fig. CXXXI.

The Height of the Cornice to the Tuscan *Pedestal divided into its Fillet and Cima being given, to find the Projection of the Fillet, and to describe the Face of the Ogee, or* Cima Reversa.

LET the Line 25, 4, be the given Height of the Fillet and *Cima Reversa*, divided at 1; and let it also represent the Face or Upright of the *Die*.

PRACTICE.

PRACTICE. Make the Angle 21, 4, 25, equal to 30 Degrees, and bisect the Line 21, 4, in 22, from whence raise the Perpendicular 22, 23, which will cut the given Height 25, 4, in the Point 1, at the Division of the Cima and Fillet, and the upper Part of the Fillet 25, 24, in the Point 23, which said Line 25, 24, is supposed to be drawn beforehand, at right Angles, to the Upright of the *Die* 25, 4; as also the Line 1, 10, from the Point 1, parallel unto 25, 24, and of any Length at Pleasure. *Secondly, 'Twas a fix'd Rule of the Antients, for to give to their Members a Projection equal to their Height; which is undeniably the most just and beautiful, and therefore to be always observ'd.* This being understood, make 25, 24, and 1, 10, each equal to 1, 4, and draw 24, 10, which determines the Projection of the Platband, or Fillet. *Thirdly*, From the Point 23, draw the Line 23, 9, parallel to 24, 10, which will cut the Line 1, 10, in the Point 9, which is the Projection of the *Cima Reversa*, and draw the Line 10. 4, which bisect in the Point 8. *Fourthly*, Bisect the Height of the Cima 1, 4, in the Point 5, and draw the Line 5, 8, parallel unto 1, 10; also draw the Line 4, 3, out at Pleasure, and parallel to the Line 5, 8. *Fifthly*, Draw the Line 5, 6, making an Angle of 30 Degrees, with the Line 1, 4; also draw the Line 8, 7, making an Angle of 30 Degrees, with the Line 5, 8, which will intersect the Line 5, 6, in the Point 2, from which draw the Line 2, 3, parallel to the Line 1, 4, and will cut the Line 4, 3, in the Point 3; and there limits the lower Part of the Cima. *Lastly*, Draw the Line 9, 3, and on each half Part thereof, erect equilateral Points, and describe the Face of the *Cima Reversa*, as required.

PROBLEM XXIII. Plate XIII. Fig. CXXXI.

A Height being given, to proportion and compleat a Tuscan *Pedestal thereto.*

LET *k*F be the given Height.

PRACTICE.

By Problem.
- XVII. Divide the given Height into its *Base*, *Die*, and *Cornice*.
- XVIII. Find the Diameter or Bredth of the Die.
- XIX. Divide the Base into its Fillet and Plinth.
- XX. Find the Projection of the Base and Fillet.
- XXI. Divide the Height of the Cornice into its Platband, and *Cima Reversa*.
- XXII. Find the Projection of the Platband or Fillet, and describe the Face of the Cima; which being done, will compleat the Pedestal, as required.

PROBLEM XXIV. Plate XIV. Fig. CXXXII.

The Height of the Tuscan *Column being given, to divide it into its Base, Shaft, and Capital geometrically,*

LET *b o* be the given Height.

PRACTICE. *First*, Bisect *b o* in *i*, and from *i* draw the Lines *a i*, and *d i*, each making an Angle of 30 Degrees, with the Line *b i*. *Secondly*, From the Point *b*, let fall the Perpendicular *b e*, on the Line *d i*, and draw the Line *a e*, which will cut the Line *b o*, in *c*, then will *bc* be the Height of the Capital, and equal unto one fourteenth Part of the whole Height. And whereas the ancient Rule for making the Height of the Base to the Pedestal, equal to its Cor-

nice

nice or Capital, so likewise they made the Height of the Base to the Column equal to the Height of the Capital thereof; and therefore make *no*, the Height of the Base, equal to *bc*, the Height of the Capital; and then will the Column be divided into its principal Parts, as required.

PROBLEM XXV. Plate XIV. Fig. CXXXIII.

The Height of the Tuscan *Base being given, to divide it into its Plinth, Torus, and Cincture, geometrically.*

Let *ar* be the given Height.

PRACTICE. *First*, Bisect *ar* in *n*, then shall *nr* be the Height of the Plinth. *Secondly*, From *n* draw the Line *xn*, making an Angle of 30 Degrees with the given Line *an*. *Thirdly*, Draw *xb* through the Point *a* and at right Angles to *ar*, which will cut the Line *xn* in *x*. *Fourthly*, Bisect *xa* in *z*, and from *z* draw *zc*, making an Angle of 30 Degrees with the Line *za*, which Line will cut the given Line in the Point *c*; then will *ac* be the Height of the Cincture, and *cn* the Height of the Torus, as required.

PROBLEM XXVI. Plate XIV. Fig. CXXXIII.

The Height of the Tuscan *Base divided into its Plinth, Torus, and Cincture, being given, to find the Projection of the Plinth before the Upright of the Column; as also the Center of the Torus, and Projection of the Cincture.*

Let *ar* be the given Height, divided into its Members at *n* and *c*.

PRACTICE. *First*, Draw the Line *or*, making an Angle of 30 Degrees, out at Pleasure. *Secondly*, From the Point *n*, let fall the Perpendicular *np* on the Line *or*; and from the Point *p*, let fall the Perpendicular *pq* on the given Line *ar*, which will cut it in the Point *q*. *Thirdly*, On the Point *r*, with the Radius *rq*, describe the Arch *qs*, which will cut the bottom Line of the Plinth in *s*, Projection; and if from the Point *s* a right Line be drawn parallel to *ar*, also from the Point *n* draw the right Line *nm* parallel to *rs*; they will intersect each other in the Point *m*, and complete the Plinth. *Fourthly*, From the Point *a* draw the right Line *al*, making an Angle of 30 Degrees with the Line *ar*, and bisect *cn* in *g*; from whence draw the Line *gi* parallel unto *nm*, which will cut the Line *al* in the Point *i*, the Center of the Torus. *Fifthly*, Let fall a Perpendicular from the Point *g* on the Line *al*, which will intersect it in *f*. *Sixthly*, Through the Point *f* draw the right Line *bh* parallel to *ar*, which will determine the Projecture of the Cincture at *bd*. And thus you see with what Beauty and Accuracy *Geometry* has divided and completed the Base of the *Tuscan* Column.

PROBLEM XXVII. Plate XIV. Fig. CXXXVI.

To describe the hollow or concave Part of a Column next above the Cincture, as de.

Let *eigk* be the Cincture to the Shaft of a Column, and let *ab* be the Upright of the Column.

PRACTICE. *First*, Continue *ge* to *c*, and make *fd* and *ec* each equal to the Projection *ef*. *Secondly*, On the Point *c*, with the Radius *ce*, describe the Arch or Quadrant *ed*; which will complete the Concave, as required.

PROBLEM XXVIII. Plate XIV. Fig. CXXXV.

To proportion, divide, and deſcribe an Aſtragal about the upper Part of the Shaft of a Column.

NOTE, The Antients divided the Semidiameter of the Column at its Baſe into ſix equal Parts, and made the Height of its Aſtragal equal to one of thoſe Parts, *viz.* five Min. or one twelfth Part of the whole Diameter.

Let am *repreſent the Upright of a Column, and equal unto one Twelfth of its Diameter, to be divided into its Aſtragal and Fillet, or Liſt.*

PRACTICE. *Firſt*, Draw the Line *ac* perpendicular unto *am*, and make *ab* equal to *am*. *Secondly*, Draw *bd* parallel to *am*, and *md* parallel to *ad*; alſo draw the diagonal Lines *ad* and *bm*; then will *bd* be the Limits of the Projection, which is equal to the Height, becauſe that *abmd* is a geometrical Square. *Thirdly*, From the Point *m* draw the Line *mk*, making an Angle of 30 Degrees with the Line *mb*, which will cut the Diagonal *ad* in *n*; on which Point, to the Line *mk*, raiſe the Perpendicular *ni*, which will cut the other Diagonal in *h*, the Center of the Aſtragal. *Fourthly*, Set the Diſtance from *o*, the Interſection of the two Diagonals, unto *h*; from *o* towards *m*, on the Semi-Diagonal *om*, as unto *p*; and draw the Line *lf* parallel unto *md*, which will divide the Liſt from the Aſtragal. *Laſtly*, Draw *ofe* parallel to *am*, which will interſect *lf* in *f*, and terminate the Projection of the Liſt; then on the Point *h* deſcribe the Face of the Aſtragal, as required.

To deſcribe the Concave or Hollow under the Liſt.

CONTINUE down *fe* unto *g*, making *eg* equal to *me*; and then on *g*, with the Radius *ge*, deſcribe the Hollow, as required.

PROBLEM XXIX. Plate XV. Fig. CXL.

The Height of a Tuſcan *Column being given, to find its Diameter, and diminiſh its Shaft geometrically.*

Let *d* 28 be the given Height.

PRACTICE. *Firſt*, By Problem XXIV. hereof, divide off the Height of the Baſe 22, 28, and Capital *bd*. *Secondly*, Since that the Height of the Capital is equal to one fourteenth Part of the whole Column, and ſince the Height of the Baſe 22, 28, is equal to the Height of the Capital, therefore the Heights of the Capital and Baſe taken together, are equal unto one Seventh of the whole Height of the Column, and conſequently the remaining Part *d* 22 is equal unto ſix Sevenths of the whole Height; therefore divide the Shaft into ſix equal Parts, as at the Points 18, 15, 10, 2, *s*; and then biſecting each of them, their Points of Biſection will be the Centers of ſix Circles of equal Radius, which deſcribe as in the Figure: Where alſo in the Places of the Baſe and Capital are Semicircles, which denote, by Inſpection, that their reſpective Heights, are each equal unto half of one of the ſix Circles, or a ſixth Part of the Shaft. *Thirdly*, If from the Extremes of the two Semicircles at *ac*, and 27, 29, the right Lines *a* 27 and *c* 29 be drawn, they will touch every Circle in its Circumference, but will not interſect it, and thereby form the Body

of

of the Column without Diminution; and then 'tis plain, that the Diameter of either of the Circles, or Semicircles, is equal to the Diameter of the Column required.

FROM Problem XXIV. hereof, with this, is ſeen the Reaſon why the *Tuſcan* Column is made of ſeven Diameters complete. For it is by Problem XXIV. that one Seventh of the whole Height is divided off geometrically to the Baſe and Capital; and by this Problem the remaining ſix are divided into its own remaining even ſix Parts, of which one is the Diameter of the Column required.

THUS much by way of Reaſon, why the *Tuſcan* Column hath been eſtabliſhed and made of ſeven Diameters high, which no one of our modern Authors have accounted for, they having been contented with telling their Readers, as Mr. GIBBS has done in his *New Rules of Drawing*, Page 5. wherein, ſpeaking of the general Proportions of the *Tuſcan* Order, he ſays, after having determin'd the Heights of the Pedeſtal and Entablature, the remaining ſhall "*be the Height of the Column, including its Baſe and Capital; and this Height being divided into ſeven Parts, one ſhall be the Diameter or Thickneſs of the Column.*" And further adds, "*The Baſe and Capital are each in Height one Semidameter of the Column.*" But gives no reaſon why they muſt be ſo, nor can their Heights be thereby known, before the Thickneſs or Diameter of the Column is known. It has been by this imperfect Manner of Writing, that young Students in Architecture are diſabled of giving a ſingle Reaſon for any one Operation they have performed.

MY next Buſineſs is, to ſhew the Manner of diminiſhing the Shaft of the Column; which I ſhall exhibit in two Manners, and begin with the moſt antient, that to *Vignola* was well known, and which he has recommended in his *Treatiſe on the Five Orders of Columns in Architecture.*

I CANNOT find that the Antients did ever aſſign any other Reaſon, that artificial or made Columns ſhould be diminiſhed, than that to diminiſh them, is to bring them as near unto natural Columns as is poſſible. By natural Columns, I mean the Bodies of ſtrait well-grown Trees, which 'tis natural to believe were firſt uſed by the Antients, for the Support of their Buildings, before the Uſe of Stone was known: And as Trees in their Growth are naturally diminiſhed, by the upper Parts being further and further remote from the Roots, and thereby receive leſſer and leſſer Nouriſhment, according to the Diſtances of the Parts from the Roots; therefore, in Imitation of Nature, it was, that afterwards, when Columns came to be form'd by the Hands of the *Artificer*, he then diminiſh'd their upper Parts accordingly.

I FIND by the *Tuſcan* Works of the Antients, that they had not any eſtabliſhed Quantity of Diminution; for in ſome of their Buildings they diminiſhed a fourth Part of the Diameter at Bottom; in others a fifth, a ſixth, and in ſome a ninth Part, as in the *Trajan* Column at *Rome*; which Difference, I ſuppoſe, ariſed from the Difference in the Heights of their Buildings, for to very high Buildings, as that of the *Trajan* Column, whoſe Diminution is but one ninth Part of its Diameter at Bottom, its own Height cauſed it to appear diminiſh'd much more than it really is; becauſe the Parts thereof are ſeen under leſſer and leſſer Angles, as they ariſe higher and higher above the Eye; and therefore ſeems to be diminiſh'd, as I ſaid before, more than

than in Fact it doth. The Reason why Columns do thus appear diminish'd, I shall demonstrate in *Perspective*, Part VII. hereof, wherein the Reason of Sight will be fully explain'd.

It is now an establish'd Rule amongst the modern Architects, to diminish the *Tuscan* Column one fourth of its Diameter at the Base, and accordingly I shall diminish it as following:

I. By the original Rule of the Ancients.

II. By the modern Rule, which the Antients knew also, but seldom practised.

And first, By the Original or most Antient Rule.

Plate. XV. Fig. CXL.

Let d 22 *be the given Height of the Shaft.*

PRACTICE. *First*, Divide the Height *d* 22 into three equal Parts, as at 15 and 2, which is done by the two lower and two upper Circles; and from the Point 15, draw out the Line 15 R, at right Angles thereto, of any Length at Pleasure. *Secondly*, Divide *d l*, the Semidiameter of the upper Circle, into three equal Parts at the Points *k* and *i*, and through the Point *k* draw the Line *f h* parallel unto the Line *a c*, and perpendicular unto the Line *d* 22; whereon place three fourth Parts of the Semidiameter of the Column at its Base, from *k* to *n*, and from *k* to D. *Thirdly*, Divide the Semidiameter 19, 22, into three equal Parts, in like manner, at the Points 20, 21, and through the Point 21 draw the right Line 23 24 parallel to the Line 27 29; which Lines *f h*, and 23 24, determine the two Hollows, or Concaves, to the Cincture and Astragal. *Fourthly*, Take the Semidiameter of the Column at its Base in your Compasses, and setting one Foot in the Point D, or Point *n*, with the other Foot intersect the centeral Line *d* 22 in the Point *l*, by the Arch *m m*. *Fifthly*, Lay a Ruler from the Point D unto the Point *l*, and it will cut the Line R 15 in the Point R. This done, and your Compasses being fix'd at the Distance of half the Diameter at the Base, as aforesaid, remove your Ruler down the centeral Line at any Distance, it matters not what or how much, as to the Point *s*, always observing to keep its Edge to the Point R; and at the same Time set off from the centeral Line, by the Side of your Ruler, the Semidiameter from the Point *s* unto the Point *r*: And so, in like manner,

Remove down the Ruler, and set the Semidiameter from the Point	*x*	unto the Point	*u*	through which Points, trace the curve Line D, *r*, *u*, 1, 5, 9, 14, 17, that will be the Content or Out-Line of the Shaft.
	2		1	
	6		5	
	10		9	
	13		14	
	15		17	

Sixthly, From the Points *r*, *u*, 1, 5, 9, 14, 17, draw right Lines parallel unto the Line 16, 17, as *pr*, *tu*, *y* 1, 3, 5; 7, 9; and 11, 14; and

make

make $\left\{\begin{matrix} 11, & 12, \\ 7 & 8 \\ 3 & 4 \\ y & z \\ t & w \\ p & q \\ n & k \end{matrix}\right\}$ equal to $\left\{\begin{matrix} 12, & 14 \\ 8 & 9 \\ 4 & 5 \\ z & 1 \\ w & u \\ q & r \\ k & D. \end{matrix}\right\}$ and then, through the Points *n p ty* 37 11, 16, draw the Contour or out Line, which completes the Shaft diminiſh'd as required.

PROBLEM XXX. Plate XV. Fig. CXXIX.

To Diminiſh the Shaft of the Tuſcan column after the uſual Method of Modern Architects.

Let b 20, be the Height of the given Column.

Practice, *Firſt*, Draw the Line 19, 21, through the Point 20, and at right Angles to the Line 20, *d*. *Secondly*, Make 18, 20. and *b d* each equal to one Fourteenth Part of the given height *b* 20, and draw 11, 12, and *e f* Parallel to the Baſe 19, 21; and then will you have divided off, the Heights of the Baſe and Capital. *Thirdly*, Make C 18, equal to one Third part of *d* 18, and through C draw *y* 7, parallel to 19, 20. *Fourthly*, make 19, 20; 20, 21; *y*, C; C 7; each equal to 18, 20; and draw the Lines *y* 19, and 7. 21. *Fifthly*, Foraſmuch as the Tuſcan Column is diminiſh'd at its Top, one quarter part of its Diameter at the Baſe, as hath been already obſerved, therefore, make *b i*, and *i k*, each equal to Three fourths of 19, 20; and then will *b k*, be the Diameter of the Column at the Top, under the Aſtragal. *Sixthly*, on the Line *y* 7 make D C, and C E, each equal to *b i*, the Semidiameter at the Top, and draw the Lines *b* D, and *k* E; alſo on the Point C, with the radius *y* C, deſcribe the Semi-circle y w 7, cutting the Lines *b* D, and *k* E in the points 2 and 3. *Seventhly*, Divide the centeral Line *i* C, into any Number of equal parts Suppoſe, four, as at the points, *n q v*, through which draw right Lines at Pleaſure parallel to y 7. *Eightly*, Divide the Arches *y* 2, and 3, 7, each into as many equal parts as you divided the centeral Line *d* C; which in this Example are four, as at the points *x z* 1, and 4, 5, 6, and then draw the Lines, 23, 1, 4; *z* 5; *x* 6; y 7; *Ninthly*, Make *v t*, *v s*. each equal to B 6; alſo *q r*, *p y*, each equal to A 5; alſo *n o*, *m n*; each equal to 9, 4; *Tenthly*, Through the Points *b m p s y*, and *k o r t* 7, draw the contour or Out-line of the Shaft, as required.

PROBLEM XXXI. Plate XIV. Fig. CXXXIV.

The Height of the Tuſcan Capital being given, to divide it into its ſeveral Moldings.

Let *a w* be the given Height.

Practice, *Firſt*, Divide *a w* into three equal parts at *m t*, and draw *m o t v* and *w y*, at right Angles to *a w*. *Secondly*, Make the Angle *w a x*, equal to 30 Degrees, and draw *a x*, *Secondly*, from x to *t*, draw x *t*, continued at Pleaſure towards *p*. *Thirdly*, Make the Angle *b a i*, equal to 30 Degrees, alſo the Angle *a m i*, and from *i*, through the point *m*, draw

the Line *i q*, cutting the Line *p* x in *q*. *Fourthly*, Make *m o*, equal to *m t*, and draw the Line *o t*. *Fifthly*, From the point *q*, draw the Line *q s*, cutting the Line *o t* in *s*. From *t* draw *t v*, parallel to *r s*, and from *s*, draw *s v*, parallel to *r t*, and then will the Lift or Annulet of the Capital be form'd.

Again, from the point *i*, draw the line *i e*, out at Pleafure. parallel to *w y*, alfo the line *a b*, parallel thereto. *Sixthly*, from the point *o*, draw the line *c o*, parallel to *a w*, cutting *i e* in *d*, and *a b* in *c*. Make *c b*, and *d e* each equal to *c d*, and draw *b e*; then is the Upper Fillet of the Abacus Form'd. *Seventhly*, Continue *b e* to *f*, making *e f* equal to *b e*, and on *f*, with the radius *e f*, defcribe the Arch *e g*, which completes the Hollow to the Fafcia of the Abacus. *Eightly*, Bifect *a* A in *k*, and from thence raife the Perpendicular *l k*, cutting *a w* in *l*, which is the Center of the Ovolo, on which with the radius *l s*, defcribe the curve, and then will the Capital be compleated as required.

PROBLEM XXXII. Plate XV. Fig. CXLI.

The Height of the Tufcan Entablature being given, to divide it, into its Architrave Freeze and Cornice.

Let *a s*, be the given Height.

Practice, *Firft*, Through the point *s*, draw the line *t s 7 o*, at right Angles to the given line, and from the point *a*, draw the right line *a o*, making an Angle of 30 Degrees, with the line *a s*, untill it meet the line *t o*, in *o*. *Secondly*, Bifect *a o*, in *l*, and at *l*, raife the Perpendicular *l m t*: cutting *a s*, in *m*, and of any length at Pleafure. *Thirdly*, Draw *s* P making an Angle of 60 Degrees, with the Line *a s*, which continue untill it meet the Line *l t* in P. *Fourthly*, from *m*. draw the Line *m n*, parallel to *s o*, and from P to *n*, draw the Line P *n*, cutting *a s*, in *q*. *Fifthly*, Bifect *m q*, in *p*, then is *p s*, the Height of the Architrave; *Laftly*, Bifect *a q*, in *i*, then *p i*, is the Height of the Freeze, and *i a*, the Height of the Cornice, as required.

PROBLEM XXXIII. Plate XV. Fig. CXLI.

To Divide the Tufcan Architrave, into its Tenia and Fafcia; and Defcribe the Profile thereof.

Let X 7. be the given Height.

Practice, *Firft*, Thro' the point *x*, draw the line *p y*, at Right Angles thereto, and of any length at pleafure.

Secondly, From the point 7, draw the line *q* 7, making an Angle of 30 Degrees, with the line *x* 7, which continue untill it meet the line *p x* in *q*. *Thirdly*, Bifect *q* 7 in 4, and thereon raife the Perpendicular 4 3; cutting the line, *x* 7, in the point 3. *Fourthly*, Bifect *x* 3 in *z*, and through the Point *z*. draw the line *q z*, at pleafure. *Fifthly*, Make *x y*, and *z* 2, each equal to *x z*: and draw *y* 2, which terminates the Face of the Tenia or Lift. *Laftly*, Defcribe the Hollow or Arch 3, 2; as defcribed for

for the Hollow of the Cincture in Fig. CXLII. and the Architrave will be completed as required. This is likewise exhibited at large in the Architrave on Plate XVI.

PROBLEM XXXIV. Plate XV. Fig. CXLI.

To Divide the Tuscan Cornice, into its Cima, Corona, *and* Ovolo.

Let *a i*, be the given Height.

Practice, *First*, Make the Angles *b i a*, and *h a i*, each equal to 30 Degrees, also make the Angles *c a i*, and *g i a*, each equal to 60 Degrees, and draw the lines forming the said Angles, untill they Interfect each other in the points *e* and *h*; from whence draw the right lines *c e*, and *h f*, at right Angles thereto, which will divide the given Height at the points *e* and *f*; and then will *f i*, be the Height of the *Cima*; *f e* the Height of the *Corona*; and *e a*, the Height of the *Ovolo*, as required.

Note, As the Triangle *a c i*, and *a h i*, are equal by having their Angles corespondently equal, therefore their Perpendiculars *c e*, and *h f*, which divide the given Height into its *Cima*, *Corona*, and *Ovolo*, doth also divide off equally the Parts *a e*, and *f i*, each being equal to one quarter of the given Height; and hence it is, that the *Cima* and *Ovolo*, are equal, and which being taken together, are equal to the *Corona*, that is compriz'd between them.

PROBLEM XXXV. Plate XVI. Fig. CXLIII.

To Describe the Profile of the Tuscan Cornice.

Let *b* 8. be the given Height.

Practice, *First*, Divide off *b x*, for the Height of the *Cornice*, and *a* 8, for the Height of the Cima, as by the last Problem, and draw out the line *b e* and x A. at Pleasure. *Secondly*, Bisect *x a* in 2, and make *x t*, equal to one fourth of *x* 2, and draw *t o*, Parallel to *b e*, at pleasure also. *Secondly*, Make the Angle 2 *x z*, equal to 60 Degrees, and draw *x z*, untill it cut the line *t o*, in *z*. *Thirdly*, Bisect *x z* in *y*, complete the equilateral Triangle *y* 1 *z*, and through the Point 1, draw the line *v p*, at Pleasure; then will you have determin'd the Height of the astragal and Fillet.

To Determine the Projecture.

First, From *w*, draw the line *w k* A, making an Angle of 60 Degrees with the line *b w*, which continue untill it meet the under part of the Ovolo at A.

Secondly, From the Point *y*, of the equilateral Triangle *y z* 1, draw the right line *f y h*, out at pleasure, and from the point A, let fall the Perpendicular A *h*, on the line *f h*, then will the Point *h*, be the Center of the astragal or *Baquette*, as *Term'd* by *Sebestian le Clerc*.

Thirdly,

Thirdly, Make *h i*, equal to *f v*, and from the Point *i*, draw the line *i*, 20, parallel to the line *x w*, which will determine the Projection of the Corona.

Fourthly, Draw *i m*, parallel to *x w*, and make *k n* equal to *k m*: Also make *k o*, and *m p*, each equal to *m n*, and draw *o p*, the Face of the Fillet. *Fifthly*, Continue *i m*, to 20, making *m* 20, equal to *v w*, and draw the right Line *w* 20. *Sixthly*, make 2 *a*, equal to *s* 2, and from the point *a*, draw the Line *a* 18, parallel to *w* 20. *Seventhly*, Make 15 18, equal to twice 18, 20, and from the point *k* draw the Line *k g*. Making the Angle 20, *k*, 9, equal to 30 Degrees. *Eightly*, Bisect 10, 15, in 13, and on the point 13, raise the Perpendicular 13, 14. *Ninthly*, on the point 13, with the Radius 13, 15, describe the Quadrant 15, 14; also on the point 12, with the Radius 12, 13, describe the Quadrant 13, 11: Likewise from the point 9, raise the Perpendicular 9, 10, and then will the Throat or Drip of the Corona be Completed.

Tenthly, Make *a* 3, equal to *a* 8, and draw the Line 8, 3. Draw the Line 3, 2, Parallel to *a w*, which Bisect, and from the point of Interfection, draw the Line 6, 1, Parallel to 8, 3, cutting the Line *w* 20, in the point 1, the under part of the Cima, being continued in the point 6;

Lastly, Bisect the Line 6, 1, in 7, and describe the Arches 8, 7, and 7, 1. Which will complete the profile of the Cornice as required.

Thus have I gone through the Geometrical Construction of every part of the *Tuscan Order of the Antients*. Which tho' perhaps, may seem to be more Tedious, than some of the following Rules; yet as 'tis what I may ventnre to call *New to this Age* (altho the most antient of all, and in itself very Easy and Demonstrable) I am perswaded that to every Lover and Judge of Arts, It will be very acceptable: For it was not without Reason the Antients thought the Rules of Geometry to be the best, by which the Orders of Architecture could be proportion'd; and more especially, because Geometry itself had its Rise from humane Bodies, which Nature has so made, as to fit all the various purposes in Life; and therefore those for Labour are made Robust and Strong; those for activity and address of a more slender and genteel Body, and the Man for Business, a mean between those Extreams. It was from the Consideration hereof, that the *antient Greeks* constituted the *three Orders of Columns*, of which the *Dorick* was made the most Massy and Strong; the *Corinthian* the most slender and delicate, and the *Ionick*; a mean between both.

The general forms of the antient Orders being thus ordain'd, they were then under a Necessity of substituting Rules by the same Art. *viz.* Geometrical Rules, by which the parts of each Order were proportion'd, so as to be agreeable to the Character it was made to Represent, of which those of the Tuscan; I have now declared, and the others will follow hereafter in their Places.

Pray Sir, in what manner had Geometry it's Rise from human Bodies.

From

M. *From a well made Man, extending the Extreams of his Body, as follows.*

First, If a good proportion'd Man be laid on his Back, and extend his Armes and Legs, as in Fig. I. Plate XLVII, and parallel right lines, be drawn to touch the Extreams of his Head, Fingers and Feet, they will at their angles of meeting generate a Geometrical Square. And the Diagonal Lines thereof being drawn, will Interfect each other, on his privies, as in the figure. *Secondly,* If the Body be extended, as in Fig II. Then a Line being extended from *n*, the Navel of his Body unto the end of his longeft Finger, fhall be the radius of a Circle, that being defcribed, will pafs by and touch the other extreams of his Body; and all lines, drawn from one part of the circumference unto the other, that doth pafs through his Navel as *n a* and *n m*, will be equal to one another.

Hence you fee, that the Circle and Geometrical Square might with very great reafon be firft taken or difcovered from a well made Humane Body fo extended; and from them all the various Properties and affections, that now form that moft Noble Science, Geometry; have arifed; by which all affairs are Govern'd and Determin'd, as will be hereafter fully explain'd, when I come to demonftrate and fhew the Ufe of Mechanick Powers.

Since the firft Inftitution of the Antient Orders, which originally were no more than the *Dorick, Jonick* and *Corinthian*, as hath been before obferved in Fol 188; The People of *Tufcany*, (a confiderable part of *Italy*) Invented another kind of Column, which they made as *Vitruvius* Obferves, the plaineft and moft Simple of all the orders, and from their Name was called *Tufcan Order*; and I think with great reafon alfo, altho' *Perrault* and other Modern Architects will argue, that it is no other than the Dorick order made Stronger, by Shortening the Shaft; And more Simple and plain, by the fmall Number of its Moldings, and largenefs of them than at its firft Inftitution.

As *Vitruvius* is the only Antient Writer on this Subject, whofe Works have been perferved; and who has not given us any part of the Compofite Order, I am therefore apt to believe that it has beenCompofed, fince his time; and was wholly unknown to the Antients before Him. Otherwife, in his ftrictSearch amongft their works, he would very probably have meet with fome which he might thought worthy of communicating to pofterity with his other works.

As I have thus taken a Slight Survey of the Orders in general, So far, as is worthy of the Workmans Notice; I fhall now proceed to the Explanation of all the Several Mafters herein,who have affign'd Proportions to the Orders, and given Examples for Practice; which with no fmall pains, and Expence, I have Collected, and Exhibited in the following Plates, and which contains fo great a Variety of ufefull Examples, that, 'tis impoffible, that any Defign can be wanted, but that, if the very thing itfelf is not here found, there are fuch that will fo furnifh the Mind with Invention; that the meaneft Capacity will be fully enabled to adapt and perfect the Defign required in an Inftant of Time To which I proceed,

I. *Of the* Tuſcan *Order, by* VITRUVIUS.

The *Tuſcan* Order of *Vitruvius* is Exhibited in Plate XVII. and hath its Meaſure determin'd by Modules and Minutes. A Module is the Diameter of the Column, at its Baſe divided into 60 equal parts, called Minutes, as the Line 4 60. which being divided but into 6 equal parts at the Points 10. 20 30 40. 50. do therefore, each repreſent ten Minutes. In Practice, 'tis ſufficient to Subdivide the firſt ten Minutes only, and the others to remain as they are, for by the Diviſion of the firſt Ten, you may take from thence with your Compaſſes, any Number of Minutes required in the ſame manner, as any Number of Feet, *&c.* are taken from a Scale of that kind. It is by this Module ,or Scale of Minutes that the Heights and Projectures of every part of an entire Order are regulated, and Determin'd ; and therefore before an Order can be began, the Diameter thereof muſt be firſt given or found. When the Diameter of a Column is given, the Scales of Minutes is moſt readily made by dividing the ſame into 60 equal parts, as before obſerved; but when the Height of the Order is given, either with, or without its Pedeſtal, then we muſt find the Diameter thereof before we can begin to make the Scale. In order thereto, we muſt add into one Sum, the Number of minutes contained inthe Height of the order; and divide the given Height, into the ſame Number of equal Parts: Sixty, of which will be the Diameter of the Column, and Module or Scale of Minutes required.

As for EXAMPLE.

	Mod.	*Min.*
The Height of the Cornice, *f*	0	35
Freeze *g k*	0	27
Architrave *k q o*,	0	45
Capital *q s*	0	30
Shaft *s b*	6	00
Baſe of the Column *a m*	0	30
Sum	8	47

Since 60 Minutes are equal to 1 Module, therefore 8 Modules are equal to 480 minutes, and the 47 min. make 527 minutes in the whole, which are the Number of Minutes contain'd in the Height of the Column and Entablature.

If to the Column its Pedeſtal, or rather Sub-Baſe, is required, which is the ſame, as that to the *Tuſcan* Order of *Palladio*, who Height is one Module ; then to the preceeding Sum 527 muſt be added 60 more, and the Sum of the Height of the entire Order, will be 587 minutes. Now to proportion this Order, to any given Height we muſt proceed as follows.

I. *Admit the given Height to be* 20 *Feet, and thereto, we are to Proportion, the Column with its Entablature, excluſive of its Pedeſtal or Sub-baſe.*

(1) By the foregoing it appears, that the height of the Column with its Entablature only, contains 527, Minutes. In 20 Feet height, there are, 240 Inches, and if we ſuppoſe each Inch, to be Sub-divided into 100 equal Parts;

Parts; then the 240 Inches contain 24000 Hundred parts of an Inch: Which being divided by 527 the Number of Minutes contain'd in the given Height, the quotient will be 45 the Number of 100 Parts, contain'd in each Minute. (2) Multiply the quotient 45 the Number of Hundred Parts of an Inch contain'd in one Minute, by 60 the Number of Minutes in one Module; and the product being divided by 100, the quotient will be the Diameter or Module required, in Inches.

EXAMPLE.

The given Height in Feet	20
Multiplied by the Inches in a Foot	12
Product	240 Inches
Which Multiply again by	100

And the Height will be reduced into 24000, Hundred parts of an Inch, which divide by 527, as following, and the Quotient will be the Number of 100 Parts of an Inch, contain'd in one Minute.

527)24000(45. Hundred parts of an Inch in one Minute
      2108

      2920
      2635

285 Remains, which is something more than $\frac{1}{2}$ a Hundred part, or 263$\frac{1}{2}$ the $\frac{1}{2}$ of 527. But as the over and above remains, are more than the $\frac{1}{2}$ of the Hundred part, in Practice is of no Notice, therefore I shall State the Quotient at 45 Hundred parts and $\frac{1}{2}$, which I multiply by the Number of minutes in a Module.

45 $\frac{1}{2}$
60

Product 2730 Hundred parts of an Inch in the Diameter or Module, which I Divide by 100, the Number of Parts into which the Inch was Sub-divided.

Inch
100)2730(27 $\frac{30}{100}$, equal to $\frac{3}{10}$ of an Inch, which is the Diameter or Module required.

P. *Pray Sir, How do you prove that* 27 *Inches and* $\frac{1}{2}$ *is the Module required.*

M. As follows, Multiply the Module found, *viz.* 2 *Feet* 3 $\frac{3}{10}$ *Inch* by the Number of Modules contain'd in the Height of the Order which are 8, and to the Product, add $\frac{3}{4}$ of 27 Inches, for the 47 Minutes, which tho' to little, because 45 Min. are equal to $\frac{3}{4}$ of a Module, yet 'tis near enough for Practice; and their Sum will be nearly equal to the given Height.

EXAMPLE.

EXAMPLE.

Feet. Inch.
2 3 $\frac{1}{20}$ the Module produced
8 The Number of Modules in the given Height

16 0
2 0
2 4
1 8 $\frac{1}{20}$ the 3 quarters of 27

Sum 19 10 $\frac{11}{20}$ which is within 1 Inch and $\frac{1}{20}$ of an Inch, of the given Height of 20 Feet. And if this Inch and $\frac{1}{20}$ be given to the Neck of the Capital, 'twill be very well dispensed with; for by the Projection of the Astragal, in large and high Columns, part of the Height of the Necks of Capitals, are take off thereby; and therefore, to make a Capital appear in good Proportion, such an allowance ought to be made, so as to Suit the Distance, which the Building is to be viewed.

The Manner of finding out such allowances will be Explain'd, in My Discourse on the manner of placeing Columns, over Columns.

2. If to the Column and Entablature, the Pedestal or Sub-Base be added, then the Height thereof (which is one module or 60 minutes) must be added to 8 modules 47 min the Height of the Entablature and Column alone, and the Height of the entire Order will be 9 modules, 47 min. or 587 minutes, which is the Divisor, by which you are to Divide, 24000, the Number of Hundred parts of an Inch in the given Height.

587 24000.(40. $\frac{520}{587}$
2348

520

The Fraction $\frac{527}{587}$ being reduced, is equal to $\frac{13}{14}$ for rejecting the last Figure 7 in both the Numerator and Denominator, the Remains of the Fraction will be $\frac{52}{58}$ equal to $\frac{26}{28}$ equal to $\frac{13}{14}$. Therefore the Quotient is 40 $\frac{13}{14}$ which are the Number of Hundred Parts of an Inch contain'd in one minute of the Orders Height.

60
13

14) 780 (55 $\frac{10}{14}$
A 70

80
70

10 remains,

and then, 40-$\frac{13}{14}$
Multiplied by 60 the Min. in a Module

2400
55-$\frac{10}{14}$

produces 2455-$\frac{10}{14}$ equal to $\frac{1}{7}$ the Number of 100 parts of an Inch in a module which being divided by 100, as before the quotient is 24 Inches $\frac{55}{100}$ equal to $\frac{11}{20}$, equal to two Feet and $\frac{11}{20}$ parts of an Inch, the Diameter, or Module required.

P. *I dont conceive. How you have performed the fore-going Multiplication, that is, In what manner did you produce the* 55. $\frac{10}{14}$

M. By Multiplying the Multiplier 60, into 13 the Numerator of the Fraction, and dividing that Product by the Denominator the quotient is 55. $\frac{4}{7}$

the

the Sum added to the Product. See this last Operation in the Margin, at A, which in Practice, is perform'd on a wast Paper by it Self. This being well understood, (and which must be, before you proceed further) we may now advance to the Delineating of the Order, according to the Measures affix'd to each Member. Wherein Observe;

First, That the Height of every Member, is signified at the centeral line *b b*, by the figures, that are there placed to be read upwards, and which signifie as many Minutes; So the number 15, placed between the two lowermost lines, signifie 15 minutes; the Height of that Member which is called the *Plinth*, from the Greek *Plinthos*, a square Brick. And the number 12 ½, placed between the *Second* and *third* lines, Signifie 12 minutes and half, the Height of that Member, which is called *Torus* from the Greek word *Toros* a Cable, which its Swelling something resembles, or rather from the Latin *Torus* a bed. and the number 2 ½ placed between the next two lines, Signifie, the Height of that Member which is called the Cincture, Fillet, or List, from the Italian *Listello* a Girdle; and so in the like manner, the same is to be understood of all the other like Numbers so placed on each Member.

The Projections of moldings or Members, are expressed by the figures placed level with the Eye, either against each Member, or otherwise between the upright line of the Column, (from which their projection are generally accounted) and their Extreams. So in such manner, on the *Plinth* there stands the Number 10, on the Cincture the Number 4, signifing that the *Plinth* projects 10 minutes, and the Cincture 4 minutes, before the line 8 *e*, which is the upright line of the column at its Base, and which is equal to the projection of the Capital. And as the Capitals projection is exactly equal to the module or Diameter of the Column, therefore its projection is equal to ½ the Diminution of the shaft at the astragal, which is 7 minutes and ½, for 45 minutes the Diameter of the shaft at the astragal, being taken from 60 the Diameter of the column at its Base, the remains is 15, one half of which is 7 minutes and ½,

To the projection of the Capital, the Engraver has plac'd the figure 8 instead of 7 ½, which is the true projection, of which you are to take Notice and correct.

Hence tis' plain, That to Delineate an Order is no more, than (when your module is prepared; That is, determin'd and divided into minutes as has been already expressed) *First* for to draw a centeral line as *b b*, and on each side thereof, draw two right lines, parallel thereto, at 30 minutes distance, as 4 *e*, and 60. *l*; *Secondly*, To draw a right line thro' any point thereof, as at *b*. at right angles thereto, for the Ground or Base line of the *Plinth*, or lowermost Member. *Thirdly*, To draw right lines parallel thereto, and at such distance from each other, as are expressed by the Number of minutes there placed for that purpose. *Fourthly* to make the length of every such line, before the upright line of the column, equal to the Number of Minutes placed there for that purpose, and then Closing their extreams, with the out line of the several moldings exhibited; the profile of the Order will be completed as required. This is so very plain and easy, needs no more to be said on this Head, and therefore as I proceed to the Orders of other Masters who Determine their measures in the same manner by the Diameter, or module divided into 60 minutes, the same is to be therein understood, as herein hath been deliverd, and therefore will be

be needless to repeat there again. I shall now proceed to my *Observations*, and *Remarks* on the whole. And *First*, Of the Base whose Height is equal to 30 minutes or ½ the Diameter of the column at its Base, including the Cincture, which in fact is a part of the shaft, and not of the Base, and therefore, ought not to be made a part of the Base, any more herein, than in all the other Orders; Where every of them Excludes it from their Base, and make it a part of the Shaft, as being Originally placed there to Strengthen the Bottom thereof,

From whom, when, or where this Error had its Rise, I can't determine: But as *Vitruvius* pass'd it over in Silence, the Architects of Succeeding ages have continued it, and every one has made the Cincture a part of the Tuscan Base, of which, with some other mistakes, I shall take further notice, when I have passed through the works of all the Masters, herein proposed.

The Plinth, being 15 Minutes high, is equal to half the height of the whole Base, and therefore mighty and strong;

It was the Practice of *Vitruvius* to take away its four Corners, and make round as expressed in the Bases to the Tuscan Intercolumnation in Plate XXXI Fig I. But notwithstanding, that *Vitruvius* was so great a Man, I must needs Join with *Perrault*, who do not think it ought to be allow'd, because the angles of the Base, answering those of the Capital, the Base would appear disabled, maim'd, and Incapable to support when depriv'd of them: I must own, that when Columns are placed within Halls, or other Publick Buildings 'tis very convenient, tho' very disagreeable to take away the corners of their Plinths, for thereby Persons are not Interrupted so much in their walking, as when they are truely Square, and therefore it is, that at some times, Beauty and order must submit to conveniency which may in many Cases be helped very greatly, as herein; If the Capitals have their Abacus round as the Plinth, or rather to have them Octagons, which is a mean, between the extreams of a Circle and a Square; then the Order would seem to be perserved, and the conveniency the same as before.

Thus far, with respect to the Base, the next in order, is the Shaft, whose thickness at the Base is continued up ⅓ part of the Height of the Shaft, and from thence is Diminished unto the Astragal, where its Diameter is but 45 min. as therein expressed.

The Capital is very particular, as having a plain Abacus without any Ogee at its top, and equal to 10 min. or ⅓ part of the whole height of the Capital.

The Ovolo under the Abacus is also the same height, and underneath is placed an astragal in manner of the *Trajans Column* at Rome Plate XLII. from whence I believe he borrowed the Hint, and which *Scamozzi* and *Perrault* only has followed; all other Architects having put only a Fillet there.

The Proportion and Character of the Entablature is very different from all the following Masters; the Architrave being not only larger than the freeze, but even than the Cornice, which 'tis very reasonable to believe he so ordain'd for the sake of strength to support it self in its Bearings, where the Intercolumnations are very great. The Projection of his Architrave, seems to be unreasonable, but when we consider, that had he placed it to be ranged with the upright of the Column, as it is all in one part, then that, and the Freeze would have appeared as one Member, and therefore to avoid that, I do suppose he gave it the projection as exhibited in the Figure It is my humble opinion, that if *Vitruvius*, had Divided the Height of his Architrave

Architrave and Freeze into 7 equal parts, as at the points *h i l n o p*, and given four to the Architrave, three to the Freeze, and Divided his Architrave into two fascia's with a tenia, as expresfed by the pricked lines *f l, i m*, and *v w*, the whole entablature would be ftrong enough and more agreable to the Eye than at prefent it appears to be.

The Height of the Entablature being 107 minutes, is 2 minutes more than ¼ the length of the Column. For 7 times 60, is 420, and the quarter 105.

II. *Of the Tufcan Order. by A. PALLADIO.*

The Tufcan Orders given by *Palladio*, are exhibited in Plates XVII and XVIII Wherein their Members are Determin'd by modules and minutes, as before done by *Vitruvius*.

In the XIV Chapter of the First Book of *Palladio concerning the Tufcan Order*, He fays, That the Column with its Bafe and Capital muft be 7 modules in length, and its Diminution a fourth part of its Bignefs (I fuppofe he means its Diameter next the Bafe) and afterwards goes on to defcribe the parts of *Vitruvius* Tufcan column and Architrave; But has quite forgot the Freeze and Cornice thereof, as well as to fpeak a fingle word concerning the Two Tufcan columns taken from the arena's of *Verona* and *Pola*, which he but juft mentions to have taken the profiles off, which that in Plate XVIII. is after the manner of *Inigo Jones*, in the portico of St. *Pauls* Covent *Garden* as exprefs'd in Plate XXVI, XXVII, and XLV

This Order I have Defcribed at Length in Figure, CXLIX. Plate XVIII, to which I have added the ogee *B* to cover the Joifts (whofe projection are a fourth part of the length of the Column, as at *St. Pauls Covent garden*, for to that of *Palladio's*, there is not any Ogee cornice on the Joifts, as herein fet forth; which I Judge to be an Omiffion or miftake.

The Members that compofe his Tufcan Order *Plate* XVII. are as follows.

A C F, Fillets or Lifts.

B. S II *Cima recta's* or Fore Ogee's, from the Greek word *Kymation* a wave, called by fome the *Throat*, *Gola*, *Geule* or *Doncine*.

D Corona, by fome called *Supercilium* or rather *Stillicidium* the Drip; The under part hereof is called by the Italians *Soffito*; by the French, *Plancere*; both fignifying no more than the Cielling. Which laft Term is moft commonly ufed by Workmen to exprefs that part of the Corona.

E Ovolo, or Echinos, a Greek word, Signifying the Shell of a Chefnut which many Workmen called *quarter round*.

G N Caveto's from the Latin, *Cavus* a Hollow.

H The Freeze from the Latin *Phrygio* an Embroiderer, or from the Italian *Freggio* a Fringed or Embroider'd Belt; the Greeks call it *Zophorus*, fignifying the Zodiack: and if in the Freeze of a Rotunda, or round Temple, the 12 Signs were depicted, it could not have an ill effect.

I The Tenia alfo called *Diadema*, a fmall Fillet with which they ufed to bind their Heads.

K L Fafcia's of the Architrave, called by fome *Fafce's*, from the Latin word *Fafcia*, a large Turban; they are alfo by fome called *Swathes* or bands.

I
K } Architrave from the Greek *Epistilium*, the lower-most principal part of
L } the Entablature.

M } the Abacus from the Greek word, *Abax*, signifying a Square Table
N } or Trencher.

Q Fascia of the Abacus.
R T. Fillets.
V Collarino.
W Astragal called by the French *Talon*, or Heel, by the Greeks *Astragalos* the Bone of the heel; The Italians call it *Tondino*, as being like a *Torus*. Some call it *Hypotrachelium*: But I think very wrongly, because Hypotrachelium denotes the Neck of the Capital, called by some, *Collarino*, the Collar, as V.
X Fillet of the Astragal
Y Cincture, Fillet or List.
Z Torus.
I'I Fillet.
IV Plinth
VI Pedestal, *Socle* or sub-Base.

It Seems that the Architect of this Column, has trod in the steps of *Vitruvius* or otherwise, *Vitruvius* in his, with respect to the *Architrave*, which has a near affinity to that of *Vitruvius*, as being much Larger than the *Freeze*, and also projects forward over the Capital in like manner. But however as the height of the Cornice is greater, and in my opinion more proportionable to the whole, than that of *Vitruvius*, the plainess thereof may be dispensed with; but were it to be divided into the *Tenia* I. and two *fascia's* K L with the same projection and Height, as Express'd by the pricked Lines and numbers placed between them, it would in most Cases, if not in all, have a much better Effect: But this is Submitted to the Consideration of those whom it may concern; as also is the Composition of the Cornice, which in my eye, has a very agreeable effect.

The next in order is the *Capital*, whose *Abacus* Q, is crown'd with a *Caveto* and *Fillet*, which in *Vitruvius* is quite plain, and instead of the *Ovolo* there next under it, here is an *Ogee* included between two Fillets; all which seems to be too great a number of parts, as not being in the least agreeable to the plainess of the Architrave, which I suppose *Palladio* also observed, Because I find he has given another Tuscan Capital of the same kind, which is Plain and more agreeable as the Capital Exhibited at Figure, CXLV. which Consists of a plain *Abacus*, with an *Ogee* between its *Fillets* in the Place where *Vitruvius* has the *Ovolo*; But tho' this Capital is Better than the other, yet I think the composition not so proper for a Capital as that of *Vitruvius* or that in Plate XVIII.

The *Base* hereof, at first view; seems to be broken into many parts, and instead of a *Torus*, an *Ogee* is introduced, which perhaps may be an agreeable Member, tho' I think not so proper as a *Torus*, whose roundness seems to be caused by the weight pressing thereon, and therefore is a natural and proper Member in that Place.

III. Of

(6) The Height of the	Mod.	Parts		Mod.	Min.
Column and Entablature	17	6	or	8	45
Pedeſtal and Column	18	8		9	20
Pedeſtal, Column and Entablature	22	2		11	5

(7) The Intercolumnations and Arcades, with their Impoſts of this Order, are repreſented in Plates XXXIV. XXXV. and XXXVI. (8) The Profile of this Order is alſo repreſented in Plate F, to follow Plate XX. where its Projectures are accounted from the central Line, according to Mr. *Evelyn* (9) As the Parts of this Order are very grand, it is beſt to be employed in magnificent Buildings, that are to be ſeen at ſome conſiderable Diſtance.

Plate F, to follow Plate XX.

BESIDES the *Tuſcan* Profiles of *Palladio, Scamozzi* and *Vignola,* here are the Profiles of *Serlio,* and that famous Column of the Emperor *Trajan,* now ſtanding at *Rome,* whoſe Meaſures are accounted from the central Line, according to Mr. *Evelyn.*

IN Plate XLII. you'll find the Baſe and Capital of this Column expreſſed more largely by *Sebaſtian Serlio,* a famous Collector of the Remains of the Antients, where Fig. I. repreſents the Pedeſtal and Baſe, Fig. II. the Capital and Plan of the Shaft, with the Stairs and Newel, and laſtly, Fig. III. repreſents the whole Column entire, whoſe Altitude is as follows, *viz.*

The Pedeſtal is one Diameter of the Column and 30 min. including the *Zocolo* or Plinth, whereon reſts the Eagles and Feſtoons.

The Column, including its Baſe and Capital, is 8 diam. and 30 min.

The Capital is 20 min. and the intermediate Members are as expreſſed againſt the Profile in Plate F. But more of this you'll find in the Explanation of Plate XLII.

Plates G, H, I, following Plate XX. *The* Tuſcan Order *by* JULIAN MAN-CLERC.

THESE three Plates repreſent the *Tuſcan* Order of this Maſter; as firſt, its Pedeſtal and Baſe of the Column in Plate G; ſecondly, the Elevation and Plan of its Capital in Plate H; and laſtly, its Entablature in Plate I. The entire Order is repreſented on the Left Hand of Plate LXXXIX. where, on its Right, you ſee, (1) That the whole Height being divided into 9 equal Parts, the Height of the Pedeſtal is equal to two of thoſe Parts. (2) That the remaining Height of the Column and Entablature being divided into 15 Parts, there are 12 to the Column, and 3 to the Entablature. (3) The Height of the Column divided into 7 equal Parts, one of thoſe Parts is the Diameter. The Height of the Baſe and of the Capital are each ½ a Diameter, and the Column is diminiſhed one Quarter of its Diameter.

NOW to ſub-divide theſe principal Parts, proceed as follows, *viz.*

(1) THE Pedeſtal, Plate G, whoſe given Height being divided into 6 equal Parts, as on the Right Hand, give the upper one to the Cornice, the other to the Baſe, and the remaining 4 to the *Dado* or *Die.* The Sub-diviſions of the Baſe and Cornice you have on the Left, the Baſe of the Column having its Height found as before, divide it, as on the Right Hand is expreſſed. (2) The Capital in Plate H, its Height being found as before, divide out its Parts, as on the Right Hand expreſſed. The ſeveral dotted Circles, inſcribed within the dotted Squares, repreſent the Plan of the Baſe and Capital. As the Ovolo of this Capital is carved into Eggs and Darts, this Maſter thought it neceſſary to inſtruct us,

How to deſcribe the Egg-Oval.

LET 3 7 be the given Breadth, which divide into 4 equal Parts; alſo divide the given Height into 3 equal Parts; or rather, which is better, firſt

 divide

divide the given Height into 3 equal Parts, and make the Breadth equal to two of those Parts; and draw the Line A B at Right Angles to 5 E; also on the Point 5 describe the Circle FG, and draw CD parallel to AB. (2) Make 7B and 3 A each equal to ¼ of the Diameter 3 7, and on the Points A and B, with the Radius AD, describe the Arches DE and CE. (3) Bisect the Arch ED, and from the Point of Bisection lay a Ruler to A, and it will cut the Line 5E in the Point I, on which, with the Radius taken from the Point I, to the said Point of Bisection, describe the Arch H, which will complete the Whole as required. (4) The Entablature Plate I. its Height being found as before, divide it into 3, giving 1 to the Architrave, 1 to the Freeze, and 1 to the Cornice; and then subdividing the Architrave and Cornice, as on the right Hand of the Profile is express'd, the Whole will be completed as required. *Note*, That this Master makes the Projections of his Members always equal to their Height.

REMARKS.

(1) THE Block Rustics, in the Base and Cornice of the Pedestal, are rather Nuisances than Ornaments, because they break the Course of the Mouldings without any Reason. (2) The Mouldings on the Left of the Base to the Pedestal would be very good for an *Ionick* Pedestal, but not for the *Tuscan*, as being too delicate, and too small for the *Die* they support: A plain Plinth would have been better. (3) The Cornice is something out of the common Way, as being crowned with an Astragal, instead of a Regula, which would, I believe, have been more masterly, and more agreeable to the Base of the Shaft, that is placed thereon, whose Torus is mistakenly carved, as is its Capital in Plate H, which have no Affinity with the plain Entablature in Plate I. whose upper Member (the *Ovolo*) is much too small for the *Corona* under it, and ought to have been made a *Cymatium*, as before observed.

Plate XXI. *The First Example of the* Tuscan Order *by* SEBASTIAN LE CLERC.

IN this Plate we have two Examples of Entablatures and Capitals, which differ very little from one another, as may be seen by comparing the respective Members of each Part, and their Measures, wherein no material Fault can be found, excepting his having crown'd both the Entablatures with Ovolo's, instead of *Cymatiums*, as they ought to have been; and that the *Dado* or Die of the Pedestal would have been more agreeable to the *Tuscan* Mode, had its Height been made 60 instead of 80 min.

Note, As by this time it is suppos'd, that the Reader is well acquainted the with *Names* of each Member in this Order, I shall therefore forbear to repeat them again. The alphabetical Letters, placed on each Member, are to distinguish one Member from another; as for Exaple, If I would remark to you any thing particularly relating to the Ovolo A, as being in a wrong Situation, *&c.* then I say, the Ovolo A is wrongly placed; but were that and the other Members not denoted by Letters, then I must say, the Ovolo of the Cornice is wrongly situated, to distinguish it from I, the Ovolo in the Capital, which is in its true Situation.

REMARKS.

THE Measures, by which these Examples are determined, is the Diameter divided into 60 min. as by *Vitruvius*, *Palladio*, &c. The Column contains 7 diam. in Height, and is diminish'd ⅕. These Entablatures do each contain 5 diam.

diam. and 40 min. in Height, which is 5 min. less than ⅕ of the Column's Length.

		Diam.	Min.
The Height of the	Column and Entablature	8	40
	Pedestal and Column	9	2
	Pedestal, Column and Entablature	10	42

Plate XXII. *Two other Examples of the* Tuſcan Order *by* SEBASTIAN LE CLERC.

THE Meaſure of theſe two Examples are the Diameter divided into 60 min. and therefore their Parts are determined as thoſe of *Vitruvius* and *Palladio.*

REMARKS.

(1) THE 1ſt Example of this Plate would be very well taken for the *Dorick* Order, had this Maſter but introduced a Triglyph in the Freeze, as *Scamozzi* has almoſt done. Nor are the Number of Members in this Cornice but 1 inferior to that of *Scamozzi,* who has 10, and here but 9. If the Aſtragal *c* had been omitted, and the Fillet *d* been made ſomething larger, giving the Remainder equally to the Cima and *Corona,* it would have been very near to that of *Palladio*'s, Plate XVII. and had a better Effect. (2) The Freeze has a good Height, with reſpect to the Architrave and Cornice; and had not that miſerable Fillet *m* been placed under the *Tenia,* the Architrave would have looked well alſo. (3) The Abacus *p q* would have made a better Figure, had not the Regula *p* been taken out of it, but to have been one Member only, as V in the Profile on the Right Hand, which, with its Ovolo W, and Fillet Y, is more becoming the *Tuſcan* Capital than any yet ſpoken of. (4) The Reſidue of the Capital ſeems to be borrowed from *Vitruvius* ; but from whence he got the manner of placing the lower Part of the Shaft on a Cavetto, without a Cincture, I know not, and which I think is as abſurd as the poor trifling Fillet under it, which bears no Sort of Proportion to the *Torus* and *Plinth,* which in themſelves are very good. (5) The Cornice and Baſe to this Pedeſtal are ſomething very unnatural, the Cornice being the very Members to the Capital of *Trajan*'s Column, F, and the Baſe is no more than a Repetition of the ſame Mouldings to the Baſe of its own Column ; and, what is yet worſe, theſe at the Bottom, which ſuſtain all the Weight, and therefore ought to be the largeſt, are made much ſmaller than thoſe under the Column, which carry the leaſt Weight. Indeed, if we obſerve the Profile Z, we may by that believe, that this Maſter was conſcious of his Miſtake, and therefore placed that there, as being the moſt able to ſupport, and of the *Tuſcan* Plainneſs, which the other hath no Likeneſs of. (6) The little Entablature on the Right is much better conſidered, and more worthy of Regard ; but it is of greater Altitude than the other, it being 112 min. and the other but 102 min. The Diminution of the Column in this Example is alſo different from the preceding, this being diminiſhed but 11 min. and that 12. (7) The Intercolumnations of this Maſter are repreſented in Plate XXXV. and his various *Tuſcan* Impoſts in Plates XXXIV. and XXXVI.

Plate XXIII. *The* Tuſcan Order *by* CLAUDE PERAULT.

THIS Maſter ſeems to have improved the *Tuſcan* Order of *Barozzio* of *Vignola,* as that the Members of his Entablature are exactly the ſame, but I think more magnificently proportioned. The Capital is very like that of *Vitruvius,* but the Baſe to the Column is the ſame of *Vignola.* The Manner of determining the Parts of this Order is as follows, *viz.*

(1) It

(1) If Pedeftal, Column and Entablature are to be introduced, divide the Height given into 34 equal Parts, of which give 6 to the Pedeftal, 22 to the Column with its Bafe and Capital, and 6 to the Entablature. (2) If the Pedeftal and Column only, without the Entablature, are to be introduced, divide the given Height into 28 Parts, of which give the lower 6 to the Pedeftal, and the other 22 to the Height of the Column. (3) If Column and Entablature only, then of the Height divided into 28, as before, give the lower 22 to the Column, and the upper 6 to the Entablature. *Note*, The Diameter of the Column is equal to 3 of the 34 equal Parts.

The Pedeftal C, divided into 4 equal Parts, as expreffed by the 4 Circles, the lower one is the Height of the Bafe, and half the upper one the Height of the Cornice to the Pedeftal. If the Height of the Bafe be divided into 3 equal Parts, the lower two is the Height of the Plinth, and the upper one the Height of its fmall Members, which being divided into 6 equal Parts, as at *g h*, give 4 to the Cavetto X, and 2 to the Fillet Y. The Height of the Cornice of the Pedeftal being divided into 8 equal Parts, give 5 to the Plat-band T, 1 to the Fillet V, and 2 to the Cavetto W. The Height of the Column being equal to 22 Parts, and 3 Parts being equal to the Diameter, therefore the total Height of the Column in Diameters is 7 and $\frac{1}{3}$.

The Height of the Bafe and Capital are each equal to $\frac{1}{2}$ the Diameter of the Column, whofe Members are divided as follows, *viz.* The Height of the Bafe *b*H being divided into 2 equal Parts, the lower one is the Height of the Plinth, and then the upper 1 being divided into 6, the lower 5 is the Height of the Torus, and the upper 1 the Height of the Cincture. The Height of the Capital being divided into 3 equal Parts, the upper one (K) is the Abacus, the next under it (L) the Ovolo, and the lower one being divided into 8 equal Parts, give the upper 2 to the Aftragal, 1 to the Fillet, and the remaining 5 to O, the Neck of the Capital. This Divifion of 8 is reprefented at T V, on the left Hand of the Capital. The Aftragal P is equal to $\frac{1}{2}$, the Neck *s t*, and the Fillet under it is equal to $\frac{1}{3}$ of the Aftragal.

The Diminution of the Shaft at the Capital is $\frac{1}{6}$ of its Diameter at the Bafe. The Height of the Entablature *a* X is divided into 20 equal Parts, of which the lower 6 is the Height of the Architrave, the next 6 the Height of the Freeze, and the upper 8 the Height of the Cornice; the upper 2 is the Height of the Ovolo A, the next 1 the Aftragal *t r*, (which being divided into 3, the Fillet C contains 1, and the Aftragal C, 2) the next 2 $\frac{1}{2}$ *r y* is the Height of the Corona D, the next $\frac{1}{2}$ *y z* the Fillet E, and the laft 2 *z* A the *Cima reverfa* F. The Projection of the Cornice *c f* is equal to *c o* the Height, and the Projections of its Parts are determined by *c f*, being divided into 12 equal Parts; then of thofe Parts the Corona projects 7 $\frac{1}{2}$, and the Fillet E, 3. The Projection of the Abacus K is equal to the Cincture Q, which is one third Part of N Q; the Projection of the Plinth S, which is equal to one fifth of the Diameter at the Cafe; the Projection of the Plinth of the Pedeftal A B is equal to G A, half its Height; and A B being divided into 5 equal Parts, from thence the pricked perpendicular Lines determine the Projections of the fmall Members.

Plate XXIV. *The* Tufcan Order *of the Antients, as practifed by Mr.* Gibbs.

The general Proportions of this Order are determined by equal Parts, as follows. (1) If the entire Order is to be made, divide the given Height, as BO, Fig. I. into 5 equal Parts, (as done by the five large dotted Semicircles) and the lower one is the Altitude of the Pedeftal. (2) Divide L A, the other four Parts, into 5 equal Parts, the upper one is the Altitude of the Entablature, and the lower 4 Parts being divided into 7, (as by the fmall Semicircles) 1 of thofe Parts is the Diameter of the Column, whofe Shaft is diminifhed $\frac{1}{5}$ Part of its Diameter at the Cafe. Thefe principal Parts are fubdivided by even Parts

Parts again, as follows. (1) *To divide a h* Fig. I. *the Height of the Pedestal, into its Base and Cornice,* divide *a h* into 4 equal Parts at *b c n,* and *c n* into 3 equal Parts at *e f,* also divide *ab* in *d,* then is *a d* the Height of the Cornice, and *f h* the Height of the Base. *To divide the Base of the Pedestal into its Members,* as in Fig. II. divide the Height *a d* into 4 equal Parts at *q b c,* then will *q d* be the Altitude of the Plinth, and *a q* the Height of the Mouldings. Divide *a q* into 6 equal Parts, give one to each of the Fillets, and the other 4 to the *Cima recta. To divide the Cornice of the Pedestal into its Members,* divide the Height into 6 equal Parts, give 1 to the Regula E, 3 to the Fascia F, and 2 to the *Cima reversa* G. (2) The Heights of the Base and Capital of the Column being each equal to half the Diameter, subdivide their Members as follows: Bisect *a i* in *e,* then is *e i* the Height of the Plinth D, divide *a e* into 4 equal Parts, and giving the upper one to the *Cincture* B, the lower three will be the *Torus* C. But here the Cincture is comprised within the Height of the Base or Semidiameter, which I cannot commend. Again, divide *s y,* the Height of the Capital, into 3 equal Parts at *n x,* then is *x y* the Height of the Neck; also *w x* being divided into 8 equal Parts, the lower one is the Fillet V, and the upper 7 the Ovolo T; and *s w* divided into 4 equal Parts, the upper one is the Regula R, and the lower 3, the Fascia S of the Abacus R S. *To divide the Entablature into its Architrave, Freeze and Cornice,* divide the given Height *a s* into 7 equal Parts, at *c g i k l r s,* give 2 to the Architrave, as many to the Freeze, and the upper 3 to the Cornice. Again, divide *l s,* the Height of the Architrave, into 7 equal Parts, give 2 to the lower *Fascia t s,* 4 to the upper *m t,* and 1 to the Tenia *l m:* The Height of the Bed-moulding *g i* is $\frac{1}{3}$ of the Cornice, the Ovolo *g n* is $\frac{1}{2}$ thereof, and the lower half *n i* being divided into 3, the upper one is the Fillet L, and the lower two is the Cavetto M. The Height of the *Corona e g* is also $\frac{1}{3}$ of the Cornice, and its Fillet *e f* is $\frac{1}{6}$ Part thereof. Lastly, the Cymatium *a c* is also $\frac{1}{3}$ of the Cornice, and its Regula *a b* is $\frac{1}{4}$ thereof. *The Projection of the Cornice* 2 8 is equal to its Height 2 24; to determine the Projectures of its Parts, divide the Projection 2 8 into 6 equal Parts at 3 4 5 6, and from those Points draw Lines parallel to 2 24, then the Line from 3 determines the Projecture of the Cavetto at 20 21, whose Center is 22; the Line from 4 determines the Projecture of the Ovolo at 18, the Point 13 is its Center, and the Line from 6 determines the Projecture of the Corona; and lastly, the Projecture of the Fillet 13 14 on the Corona is equal to its Height. The Cima is described on the Intersections made at 11 12, with the Radius of $\frac{1}{2}$ of 13 10, on the Points 9, 10, 13. *The Projecture of the Capital* 31 D *and t q* are each equal to $\frac{1}{4}$ of the Diameter of the Column at its Neck, as $\frac{1}{4}$ of *q* 31. Divide 31 D into 6 Parts, the first one determines the Projecture of the Fillet V at *b c,* the fifth the Fascia S, of the Abacus R S. *The Projecture of the Fillet* Y *under the Astragal* is equal to its Height, as also is the Astragal, its Height, beyond the Fillet, thereby forming a Square, whose Center is the Center of the Astragal. *The Projecture of the Base to the Column* is equal to $\frac{1}{6}$ of the Diameter; and as the Torus and Plinth are always of equal Projection, and as the Center of the Torus is set back from its Extreams equal to $\frac{1}{2}$ its Height, therefore from its Center *y* draw a Right-line, as *y s,* which will terminate the Projecture of its Cincture B. *The Projecture of the Cornice to the Pedestal,* 3 7 *and* 19 20, are each equal to $\frac{1}{8}$ of the Plinth 7 19: Divide the Projection 19 20 into 4 Parts, then 2 Parts is the Projection of the *Cima reversa* G, and 3 Parts of the Fascia or Plat-band F. *The Projecture of the Dado or Die* is always equal to the Projection of the Plinth of the Column's Base. *The Projecture of the Base to the Pedestal* is equal to that of its Cornice, the Fillet I, and Cima recta K to their respective Heights, and thus is the whole Order compleated. This Composition of the Cornice is the same as that of *Palladio*'s, but not so good, the Bed-moulding K L M being too small for the Corona and the *Cymatium* being fitter for *Dorick*; and had his Architrave been made into one Fascia with the *Tenia,* and the

Abacus of his Capital made plain, as the Abacus to the Capital of *Palladio*'s in Plate XVIII. 'twould have been more agreeable to the *Tuscan*, as well as nearer the Examples of *Palladio*, whom he pretends to have chosen for his Master. The Method of determining each Member by equal Parts was known and practised by many Architects long before his Time, of which I give you here many Examples in every Order, by *Julian Mau-clerc*, *Perault*, and [illegible] made use of equal Parts, as will be hereafter declared in the preceding Orders.

Plate XXV. *The* Tuscan Order *by* SEBASTIAN SERLIO.

HAD this Master crowned his Order with a *Cymatium* instead of an *Ovolo*, it would, for simple Beauty, have exceeded all others. The entire Height of this Order being divided into 19 Parts, (as represented by the 9 Circles *a*, *c*, *e*, &c. and Semicircle *pq*, Fig. II.) give 4 to the Pedestal, 12 to the Column, and 3 to the Entablature. *To divide the principal Parts of the Pedestal*, divide the Height into 6, give 1 to the Base E, and 1 to the Caping D. *The Diameter of the Column* is equal to ⅙ of its Height, and therefore its Height is but 6 Diameters, and its Diminution is a fourth Part of its Diameter. The Cincture A is included in the Base. *The Height of the Base and Capital* is each equal to ½ of the Diameter. *To divide the Mouldings of the Base*, divide *ag* the Height into two equal Parts at *e*, then *e g* is the Height of the Plinth; also divide *ae* into 4, then the upper one is the *Cincture*, and the lower 3 the *Torus*. *To divide the Mouldings of the Capital*, divide 18 43, the Height of the Capital, into 3 equal Parts at 10 and 42, then the upper 1 is the Abacus Q, the lower 1 the Neck T, and the middle 1 the Ovolo R, with its Annulet S, which is ¼ Part thereof. *The Astragal* V *with its Fillet* W is equal to ½ the Neck T; divide these into 3, give the upper 2 to the Astragal, and the lower 1 to the Fillet. *To divide the Entablature into its Architrave, Freeze, and Cornice*, divide the Height *n* 18 into 3 Parts, then the lower 1 is the *Architrave*, the middle 1 the *Freeze*, and the upper 1 the *Cornice*. Here you see *Serlio* has given us two Varieties of Entablatures: That on the Right is divided as follows, *1st*, The Architrave 11 18 being divided into 6, give the upper 1 to the Tenia K L. which subdivide into 3, and give the upper 1 to the small *Regula*. The two Fascia's O, P, are each equal to 2 Parts and ½. *2dly*, The Height of the Cornice *n w* divided into 4, the lower 1 is the Bed-moulding G H, which subdivide into 3, give 1 to the Fillet G, and 2 to [illegible] H; the next 2 Parts *q s* is the Height of the Corona F; and the upper Part divided into 3, the upper 2 is the *Ovolo*, and the lower 1 its *Fillet*. The other Entablature on the Left is divided as follows, *1st*, The *Tenia* M is ⅙ of the whole Architrave; the Height of the Cornice divided into 4, give the lower 1 to the Plat-band C, the upper 1 to the Ovolo A, and the middle 2 to the *Corona* B. The Projection of the Cornice is equal to its Height, that of the Capital to the Diameter of its Shaft, and that of the Plinth to ⅙ of the Diameter. Divide *l n* the Height of the Caping to the Pedestal D into 4 equal Parts, and make its Projection *q r* and *l k* each equal to ¾ thereof. The Projection of the Pedestal's Base is equal to that of the Caping, and that of the *Dado*, or Die, to the Plinth C. ☞ The Profile of this Order is also represented in Plate F, to follow Plate XX. where its Members are determined by Modules and Minutes, accounted from the central Line, according to Mr. *Evelyn*.

Plate XXVI. XXVII. *The* Tuscan Order *by Mr.* STONE *in the* Portico *of* St. Paul's, Covent-garden.

THIS Order is built in the Portico of the Church aforesaid, whose simple Grandeur excels all other Buildings in this City. The Construction of this Portico is as follows: Let G L be the given Breadth, and through its Extreams

treams GL, draw the Right-lines A B and M Q, which ſhall be the central Lines of the extream Columns; divide GL into 6 equal Parts, then, with the Radius GH, which is $\frac{1}{6}$ of GL, thereon deſcribe the 4 Circles, cutting GL in H I K: With the ſame Radius deſcribe two Circles on the Line G B, touching each other at F D; perform the ſame on the Line M Q, then will the Points B Q be the under Part of the Plinth to the Columns, and the Line N Z, drawn thro' the Points FO, is the upper Part of the *Cima recta*, whoſe Projection is equal to the Radius FE, and conſequently to one fourth Part of F B, the Height of the Order. If IM is made equal to GA, and the Lines NM and MZ be drawn, then will the Triangle NZ, NM, and MZ, exhibit the Pitch of its Pediment, whoſe perpendicular Height is equal to half the Height of the Order that ſuſtains it, as is evidently demonſtrated by the large Circles which meaſure the ſame.

To divide the principal Parts of the Order.

(1) DIVIDE PQ into 9 equal Parts at *f*, W, *e*, X, *d*, Y, *b*, Z, Q, then ZQ is the Height of the Baſe, which doubled is the Diameter of the Column. (2) Divide the Height OZ into 3 equal Parts, or rather into 6, and then OS, the upper 6th Part, will be the Height of the Entablature. If SZ be divided into 7 equal Parts, one of thoſe Parts is the Diameter of the Column, and will be equal to twice ZQ, the Height of the Baſe before found. (3) Make the Height of the Sub-plinth Q equal to the Height of the Baſe.

THE Entablature, Fig I. having its Height *a s* divided into 6 equal Parts at *x*, *f*, *g*, *q*, *r*, the lower 3 is the Height of the Architrave, and the upper 1 the Cymatium and Aſtragal included, and the next one is the Height of the Modillion, whoſe Projection is equal to the Height of the Entablature. The Projection of the Plinth is a ſixth Part of the Diameter at the Baſe, and the Projection of the Cincture is half thereof. The Abacus of the Capital has the ſame Projection as the Cincture, and the Diminution of the Shaft is $\frac{1}{4}$ of the Diameter at the Baſe. The Height of the Capital is a twelfth Part more than the Semidiameter at the Baſe, which I ſuppoſe is allowed with reſpect to the Projecture of the Aſtragal, which, when we are near the Building, eclipſes a Part of its Height, and therefore this extraordinary Height is juſtifiable.

PLATE XXVIII. Fig. II. exhibits the *Tuſcan* Order of *Inigo Jones*, as 'tis executed in the Frontiſpiece at *York-ſtairs*, whoſe entire Height *a 5* being divided into 5 equal Parts, at *b*, *g*, *p*, *y*, the upper one *a b* is the Height of the Entablature, and the lower 4 being divided into 7 equal Parts, at *e*, *h*, *l*, *r*, *w*, 2, one of thoſe Parts is equal to the Diameter of the Column. The Diameter of theſe Columns is preciſely two Feet, and therefore the Diameter, Fig. I. is divided into 24 Inches, and is the Scale by which the Whole is delineated. This Compoſition is not unlike that of *Barozzio* of *Vignola*, in every reſpect, the Cincture Q excepted, which differs from all I ever ſee.

THE ſeveral Figures affixed hereto, to denote the Heights and Projectures of each Member, are Inches and Parts of Inches, as their ſeveral fractional Numbers expreſs.

Plate XXVIII. *The* Tuſcan Order *by* INIGO JONES, *at* York-Stairs.

THIS ſo much celebrated Maſter would have made a fine Compoſition here, had he placed a Cymatium on the Corona, inſtead of an *Ovolo*, which I have already obſerved to be abſurd. The remaining Parts of the Order are very noble, ſave its Baſe, where I think its Torus S is too ſmall, and Cincture R too large: Had the Torus been made 5 Inches inſtead of 4 Inches, and the Fillet 1 Inch inſtead of 2 Inches, they would have been better proportioned than

than they are, to the great Parts they fuftain. The Cavetto Q is very abfurd, as is the Manner of the Shaft fitting on it: In fhort, the Cincture R and Cavetto Q fhould have been a Part of the Shaft, and not a Part of the Bafe, as they are made to be. The Height of the Column is 7 Diameters, the Height of the Entablature ¼ of the Column's Length; the feveral Members are determined by Inches and Parts of Inches, both in their Heights and Projectures. *To rufticate this Column*, divide the Length of the Shaft *c* 4 into 17 equal Parts at *c*, *d*, *f*, *&c.* then give two to each Ruftic, and the like to each Interval, except the upper Interval, which muft be but 1, as *c d.* The Projections of the Ruftics are determined by Lines drawn from the Projections of the Cincture F and G, unto the Projection of the Aftragal 7 and 8.

P. *Pray, Sir, why were Columns firft rufticated?*

M. To ftrengthen their Shafts, by binding their Parts clofely together, fo as not to fuffer them to burft or fplit by very great Weights, that were then impofed on them. Therefore to rufticate Columns, that do not fuftain great Weights, is a great Abfurdity; of which the moft ridiculous Examples I have feen are the Columns in an *Ionick* Frontifpiece to the Entrance of the Court-yard, before the Lord *Burlington*'s old Houfe at *Chefwich*, and thofe to the Frontifpiece of the *New Play-houfe*, in the Piazza of *Covent-Garden*. Nor can I indeed very juftly commend Mr. *Inigo Jones* in this Example: But as they are done in a Grotefque Manner, upon the Brink of the River *Thames*, intended more for Ornaments than Strength, they are therefore not to be condemned, nor very greatly commended: For a Rural Grotefque Frontifpiece, like unto the Entrance into a Cave or Grotto, would have been much more fuitable to that Place, than a regular Piece of Architecture. Thefe lead me to obferve to you, the fame Abfurdities in the rufticated Columns to the Frontifpiece of Lord *Burlington*'s Gate in *Piccadilly*, and thofe againft the *Meufe* Stables, *Charing-crofs*; where in both thefe Buildings, the Columns are not only rufticated, without any impofed Weight, fave that of their broken Entablatures, but their Surfaces allude to different Situations from thofe they poffefs: For thofe *Ifcles* in *Burlington*-Gate, would have better becomed the Situation of *York*-Stairs, or the Entrance to a Grotto, than that to a Nobleman's Palace in a common high Road. And thofe defaced Ruftics of the *Meufe* are but a Monkey Affectation (of Antiquity, as if worn fo by Time, or caufed fo by Nature,) being no wife fimilar to the other Parts of the Building, or agreeable to the Age in which the Date of the Year placed over them denotes their being erected.

Plate XXIX. *The* Tufcan Order *of Sir* CHRISTOPHER WREN, *in the* Frontifpiece *of* St. Antholine'*s Church in* Watling-Street, London.

THE Compofition of this Order is the fame as the foregoing of *Inigo Jones*, excepting in the Bafe to the Column, wherein this Mafter has very wifely excluded the Cavetto above the Cincture, and given a better Proportion to the *Torus* and *Plinth*. To proportion this Order to any Height is a Work of fome Trouble, as that the Height of the Entablature, which is but 1 diam. ¾, bears no good Proportion to the Height of its Pilafter, which is of 7 Diameters; and indeed I am furprifed to find fo fmall an Entablature, by fo great a Mafter; it being actually 25 min. too low, to be equal to a quarter Part of the Pilafter's Height, which it ought to have been. *To proportion this Order*, divide the given Height into 25 equal Parts, or rather into 5 Parts; and then dividing the upper one into 5, give the upper four to the Entablature, and the Refidue of the Whole to the Column. The Height of the remaining 21 Parts being divided into 7, take 1 for the Diameter. *To divide the Bafe into*

its

its Mouldings, divide *xa* (which is equal to half the Diameter) into 19 Parts, give 10 to the Height of the Plinth, 8 to the Torus, and 2 to the Cincture. *To divide the Members of the Capital*, divide *ao*, which is equal to *ap* the Semidiameter, into 3 Parts at *df*; divide *fo* into 8 Parts, and make *no* equal to $\frac{1}{8}$ of *fo*, and draw *n*D for the upper Part of the Aftragal: Again, divide *p*8 into 6 Parts, give the lower 2 to the Neck 6 8, half the next 1 to the Annulet, the next half to the Ovolo, the next 1 $\frac{1}{2}$ to the Abacus, which fubdivide into 3, and give 1 to its Regula. *To divide the Entablature into its Architrave, Freeze, and Cornice*, divide *ap* its Height into 27 Parts, give 8 to the Architrave, 8 to the Freeze, and 11 to the Cornice. *To divide the Tenia of the Architrave*, divide *bp* into 9 Parts, and give 2 to the Tenia. The Cornice being divided into 11 Parts, the upper 3 is the Height of the Ovolo, the next 1 of the Aftragal, and half the next 1 of the Fillet. Divide *dx* into 2 equal Parts, and the lower 1 of thofe 2 Parts into 3 Parts, then give 2 of thofe Parts to the *Cima reverfa t x*, whofe Fillet is $\frac{1}{6}$ thereof.

The Projection of the Cornice fg is equal to its Height *f* 10. *The Projection of the Capital* is equal to $\frac{1}{3}$ of the Height from the under Part of the Fillet to the Aftragal, unto the upper Part of the Abacus. *The Projection of the Bafe* is (fomething very odd, being) 2 thirteenth Parts of the Diameter 3 O, which is equal to the Diameter, being divided into 13 Parts, at B, C, D, E, &c. 8 A 3, and OP 5, are each equal to $\frac{2}{13}$ of 3 O. ☞ *The feveral Figures placed againft the Members fignify no more, than References to thofe Parts, when we need to mention any of them particularly. To rufticate this Column or Pilafter*, draw *k l p q* parallel to the Cincture *ms*, and at fuch Diftance from it, as to be juft clear of the Curve; divide the upper Part from *o*, to the under Part of the Fillet to the Aftragal, into 10 equal Parts, and each of thofe Parts into 6; then give 5 to the Ruftick, and 1 to the Rabbit, Groove, or Channel, as fignified by the fmall Circles between *e* and *o*, Fig. I. The Projecture of the Rufticks is equal to that of the Cincture.

Plate XXX. Tufcan *Intercolumnations, Arches, and Impofts, according to the Ancients.*

FIG. I. An Impoft at large. Fig II. Intercolumnations for Portico's or Colonades. Fig. III. Arches, or Arcades on Sub-plinths. Fig. IV. Arches, or Arcades on Pedeftals, whofe Impofts ZZ and SS are reprefented by Fig. I. The Proportions of the principal Parts are exhibited by the large Semicircles and Circles, and thofe of the particular Parts by the leffer Circles; all which, being very plain by Infpection, need no further Explanation.

Plate XXXI. Tufcan *Portico's to Temples by* VITRUVIUS.

THESE three Figures do not only exhibit, by the proportional Circles, the proper Intercolumnations of this Order, but the Proportion of Portico's to *Tufcan* Temples alfo, which Infpection will better explain, than Words can do.

Plate XXXII. Tufcan *Intercolumnations, Arches, and Impofts, by* A. PALLADIO.

As the Meafures and proportional Circles demonftrate the Magnitudes and Proportions of their feveral Parts, I need not fay any thing thereof; and therefore I fhall only note, that if the Semicircle O *h g v* be divided into 11 Parts, the Key-ftone will be one of thofe Parts.

Plate XXXIII. Tuſcan *Intercolumnations by* VINCENT SCAMOZZI.

As all the ſeveral Members of theſe *Portico's* and *Arches* have their reſpective Meaſures affix'd to them, as likewiſe are to Fig. V. VI. VII. which repreſent his various Impoſts, Architraves, and Entablatures, no more need be ſaid relating thereto.

Plates XXXIV. XXXV. XXXVI. Tuſcan *Intercolumnations, Arches, and Impoſts, by* BAROZZIO *of* Vignola, *and* SEBASTIAN LE CLERC.

The Intercolumnations for *Portico's* and *Colonades* by *Barozzio* are repreſented by Plate XXXIV. and thoſe for Arches or Arcades to Piazza's by Plates XXXV. XXXVI. where the firſt repreſents the *Tuſcan* Arch without Pedeſtals, and the laſt, with Pedeſtals. The Intercolumnations for Colonades and Arches by *Le Clerc* are repreſented by Fig. II. and III. at the bottoms of Plates XXXV. and XLII. alſo by Fig. I. II. III. IV. V. VI. of Plate XLIII. and his various Impoſts and Architraves for thoſe Arcades are exhibited at the bottoms of Plates XXXIV. and XXXVI. The Meaſures to *Barozzio*'s are Modules and Parts, (the Semidiameter being the Module divided into 12 Parts, as before obſerved) and thoſe of *Le Clerc*'s are Modules and Minutes, wherein the Semidiameter of the Column is accounted the Module divided into 30 Minutes.

Plates XXXVII. XXXVIII. XXXIX. XL. XLI. Tuſcan *Triumphal Gates, Arcades, Intercolumnations to Colonades, Niches, Doors, and Windows, by* SEBASTIAN SERLIO, *and* JULIUS ROMANUS.

To delineate the Tuſcan *Triumphal Gate or Entrance,* Fig. I. Plate XXXVII.

(1) Divide the given Breadth into 12 equal Parts, as demonſtrated by the 12 Circles E, D, C, &c. then will one of thoſe Parts be the Diameter of the Pilaſters. (2) Make the middle Opening equal to 3 Parts, and the ſide Openings each equal to 1, and then complete the Order, throughout its Height, by the Diameter before found. (3) Make *d f* equal to half the Height *f r*, then the whole Height is in 3 equal Parts. (4) Divide *d f* into 7 Parts, then the upper 2 is the Height of the Pediment; the out Lines of the middle Pilaſters, being continued to K and G, terminate the Extent of the *Attick* Pilaſters K I and H G. (5) Divide the Height of the Pilaſters into 15 Parts, which terminate with curved Lines, repreſenting their ruſtick Swellings, making the 9th Ruſtick from the Baſe the Impoſt of the Arch. (6) Divide the ſemicircular Arch into 19 Parts, that the middle one (*h*) may ſtand perpendicular to the Diameter of the Arch, which will complete the Whole. *Note,* The Diviſion *h o n m l k i*, and the Semicircle *p d q* are uſeleſs in this Conſtruction.

REMARKS on Fig. I. *and* Fig. II. Plate XXXVII.

(1) The Breaking off the Architrave and Freeze, for the ſake of enlarging the Ruſticks of the Arch, is abſurd, and deſtroys that noble Look of continued Entablature, as is ſeen in Fig. II underneath: It is alſo a weakening to the Whole, and therefore not to be practiſed. (2) If the Number of his Ruſticks were fewer, they would be more grand and noble, the Whole being (If I am not miſtaken) broken into too many Parts.

Fig. II. is another Gate of this Maſter, which is not ſo much to be condemned, but indeed may be received as a good Example; but I would recommend, that circular Receſſes, for the Reception of Buſto's, be made in the Places

Places of the ſquare Apertures 6 and 5, which Apertures, appearing as Windows, have not ſo noble an Effect. As the proportional Circles E, D, C, B, &c. demonſtrate the given Breadth is divided into 15 Parts, of which 1 Part is the Diameter of the Column, the Height of the Order and its Parts is from thence determined, as before has been taught at large; by which you may complete the Whole as required.

PLATE XXXVIII. Fig. I. is a *Tuſcan* Frontiſpiece of *Serlio*'s, of very uncommon Proportion, *viz.* Its Intercolumnation is but 3 diam. and ½, its Pilaſters but 6 diam. in Height, and, what is yet more odd, the Height of the Baſe is but ¼ of the Diameter, and Height of the Capital but ⅓, which, tho' Preſidents, are not to be followed; therefore I recommend, that when any ſuch Deſign as this be required, make the Height of the Baſes and Capitals each equal to half the Diameter of the Pilaſter or Column, for otherwiſe they will appear too ſmall for the Shaft they belong to. Fig. II. is an Arcade for Piazza's of Columns in Pairs, to be uſed where a great Weight is to be ſupported over them in the ſecond Story.

PLATE XXXIX. Fig. II. repreſents a *Tuſcan* Arcade for Piazza's alſo, to be uſed where the Weight above is not ſo great as the aforeſaid, and when much Light is required below. Fig. I. is a *Tuſcan* Gate ruſticated after the Manner of *Julius Romanus*, wherein 'tis to be obſerved, (1) That he makes the lowermoſt Ruſtick the Baſe of the Column: (2) That his Columns are diminiſhed immediately from their Bottoms unto their Capitals: And laſtly, That he has abſurdly broken the Architrave and Freeze, as *Serlio* has done before him in Plate XXXVII.

PLATE XL. Fig. I. repreſents *Tuſcan* Niches, which are of good Compoſition for Groteſque Works; as alſo is the *Tuſcan* Door, Fig. II. But the double Arch to Fig. III I cannot commend, for if the ſtreight Arch *aa*, &c. have good Butments, there's no occaſion for the Semicircle A over it, to diſcharge off the Weight, the other being ſtrong enough of itſelf: Indeed, in ſome Caſes, it is required to let in Light at A; but, when ſuch Demand is made, pray why may not the ſtreight Arch be taken away, and its Height turn'd into an Impoſt, and ſtopt over each Side of the Window, with an agreeable Projection, thereby giving to the Whole a noble Aſpect? From whence *Serlio* got this abſurd Method I know not, but ſure I am, that many modern Pretenders to *Architecture* have copy'd and practiſed it, not only in the Doors of the *War-office*, by the *Horſe-guards*, at *White-hall*, and to the Doors of *His Majeſty's new Stables* in the *Meuſe*, but many other Buildings in and about *London*, as not being able to judge of the Abuſe.

PLATE XLI. exhibits another ruſticated Arcade for Piazza's, with a ruſtick Gate not unworthy of our Regard, where Strength and ſimple Beauty are to be expreſſed at the ſame Time.

Plate XLII. *The* TRAJAN'*s Column at* Rome, *by* SEBASTIAN SERLIO.

FIG. III. repreſents the Column erected by the *Senate* and *People* of *Rome*, in Recognition of thoſe great Services that the Emperor *Trajan* had rendered his Country, and indeed it is one of the moſt ſuperb Remainders of the *Roman* Magnificence to be now ſeen ſtanding; and, that it might more immortalize him, than all the Pens of Hiſtorians could do, they cauſed this Column to be made of Marble, on whoſe Shaft they engraved, in Bas-relievo, all his memorable Acts, by the moſt exquiſite Hands, without Limit of Expence therein, to perpetuate his Memory to all ſucceeding Ages, and to continue as long as the very Empire itſelf; and which, for their Excellency of Workmanſhip, are juſtly admired by the whole World.

THAT noble Encourager of Arts and Sciences, *Lewis* XIV. of *France* cauſed 70 of the Bas-reliefs of this Column to be moulded, ſome of which were caſt in Braſs, and the others employ'd to incruſtate and embelliſh the arch'd Cieling to the great Gallery in the *Louvre*.

As

As many of our *English* Nobility have taken pleaſure to erect *inſulate* Columns, in their Gardens and Parks, to the Memories of their Friends; and which are not only very great Marks of Gratitude and affectionate Love, but Ornaments alſo; I muſt therefore deſire my young Readers, not to paſs over the Conſideration hereof in a ſlight Manner, but conſider well their Nature and Uſe; ſo that, when it may be required to raiſe a Column for any ſuch Purpoſe, they may readily know, how to complete the Compoſition agreeable to the Subject its made to perpetuate.

Now, to make this more plain, I will deſcribe this Column in the Words of Mr. *Evelyn*, as follows: " The firſt, and as it were the Foundation of the " whole Structure, is the Pedeſtal, which is here no leſs neceſſary, than is the " Cornice to the Columns of the other Orders; and its Proportion, though " ſquare and ſolid, requires an Enrichment of handſome *Modenatures*, and of " all other Sorts of Ornaments at the *Plinth* and *Cymatium*; but above all in " its four Faces or Sides of the Die, which are as it were *Tables of Renown*, " where ſhe paints the Victories of thoſe Heroes to whom ſhe erects ſuch *glori-* " *ous Trophies* (See Plate F, following Plate XX. where the principal Parts of " this Column, with its Meaſures in Minutes, are exhibited, with their Em- " belliſhments, &c.) It is there that we behold all the military Spoils of the " Vanquiſhed, their Arms, the Machines they made uſe of in Fight, their " Enſigns, Shields, Scimeters, the Harneſs of their Horſ s, and of their Cha- " riots, their Habiliments of War, the Marks of their Religion, and, in a " Word, whatever could contribute to the Pomp and Magnificence of a Tri- " umph. Upon this glorious *Booty*, as on a Throne, is erected, and reveſted " with the moſt rich and ſplendid Apparel which Art can invent, and indeed, " provided the Architect be a judicious Perſon, it cannot be too glorious. I " repeat it again, that this ought in no ſort to alter, or in the leaſt confound, " the Proportions and *Tuſcan* Profiles of the Baſe and Capital, as being the " very Keys of the Concert and Harmony of the whole Order. The laſt, but " principal Thing, becauſe it ſets the Crown upon the whole Work, is the " Statue of the Perſon to whom we erect this ſuperb and magnificent Struc- " ture: This hath an *Urn* under his Feet, as intimating a Renaſcency from " his own Aſhes, like the *Phoenix*, and that the Virtue of great Men tri- " umphs over *Deſtiny*, which has a Power only over the Vulgar." Fig. I. exhibits a Profile of the Pedeſtal and Baſe of the Column at large, as Fig. II. doth of the Capital, and Plan of the Stairs within the Shaft. The Circles B and A taken together denote the Thickneſs of the Shaft at its Baſe, the Circle A the Thickneſs of the Shaft next the Aſtragal, the Circle C the Going of the Stairs, and the Circle D the Well-hole or Newel.

Serlio meaſured the Parts of this Column with the old *Roman* Palm (which I think is equal to 9 of our Inches) divided into 12 equal Parts, called Fingers, and each Finger (being again) ſubdivided into 4 equal Parts, were called Minutes; ſo that in 1 Palm there are 48 min. The Height of the Pedeſtal, with the Sub-plinth, on which reſts the four Eagles, he ſays is 21 Palms 8 min. the Column, including its Baſe and Capital, 148 Palms 32 min. and the *Urn* on the Capital, with its Crown, 14 Palms 24 min. which together make 184 Palms 16 min. equal to 138 Feet 3 inch. The Breadth of the Pedeſtal's Die is 24 Palms 6 min. on whoſe Faces are cut two Compartments of many Trophies, with the following Inſcription:

S. P. Q. R.

IMP. CAESARI DIVI NERVAE. F. NERVAE.
TRAIANO AVG. GERMANIC. DACICO
PONT. MAX. TRIB. POT. XVII. COS. VI. PP.
AD DECLARANDVM QVANTAE ALTITV-
DINIS MONS ET LOCVS SIT EGESTVS.

The

The Diameter of the Column at its Base 16 Palms, and 14 Palms at its Astragal; so that its Diminution was but $\frac{2}{16}$ or $\frac{1}{8}$. The Height of the Base is precisely 8 Palms, and the Height of the Capital $\frac{2}{3}$ thereof. The Height of the Column, including its Base and Capital, is 8 diam. and a half; so that we are here to observe, that, altho' its Members are chiefly *Tuscan*, yet its Altitude is really *Dorick*, as indeed are its Flutings, which are without Fillets.

Plates XLII. *and* XLIII. Tuscan *Intercolumnations by* SEBASTIAN LE CLERC.

PLATE XLII. Fig. V. represents the Intercolumnations of this Master, for Columns in Colonades, which are determined by Modules and Minutes, as affixed in their Places; as also are the Intercolumnations of the Arcade, Fig. IV. Plate XLIII. represents six Examples of Intercolumnations to Arcades, for Piazza's; of which Fig. I. and Fig. II. are with Pedestals, to be used either with single, three-quarter Columns, or Columns in Pairs, detached free from the Wall, with Pedestals behind them, as their Plans express, as the Nature of the Case may require. Figures V. and VI. are also with Pedestals; but these our Master has given, as Examples to be practised, when Pilasters are to be used instead of Columns.

FIGURES III. and IV. are arcaded Intercolumnations, without Pedestals, whose Measures being signified by Modules and Minutes, need no further Explanation.

Plate XLIV. *The* Intercolumnation *of the* Portico *of* St. Paul's, Covent-garden.

THIS Building, I have already noted, was built by Mr. *Stone*, and not by Mr. *Inigo Jones*, as most do imagine, and indeed as I did myself, when I measured the Columns in the Portico; but happening, soon after my Measurement, to be speaking of it to my worthy Friend, Sir *James Thornhill*, deceased, he did assure me, that Mr. *Stone* was the Architect of that Building; but whether it was his own Design, or Mr. *Jones*'s, I will not undertake to say. *To proportion this Portico*, (1) divide the given Breadth into 4 equal Parts at *g*, *h*, *i*; also divide the 2 outer Parts, *d g*, and *i f*, each into 2 equal Parts, at *l* and *m*, which are the Places, where the two outer Columns are to stand. (2) Divide *l m* or *p g* into 13 equal Parts; then give 4 to *p r*, and the like to *v q*, so from the Points *r*, *v*, must the central Lines of the inward Columns be raised. The Altitude of the Cornice *b* is equal to *d h*, the half Breadth; and *a b*, the Altitude, or Pitch of the Pediment, is equal to half *b d*, as is plain by the proportional Semicircles, which exhibit the whole by Inspection. The Manner of dividing the particular Members is shewn in Plates XXVI. XXVII.

FIG. II. and III. are Examples of *Tuscan* Frontispieces for Doors, of which Fig. II. is a double Example, having a Balustrade on the right Hand, and a Pediment on the left; which last Example exhibits the Effect, that a Pediment hath with a semicircular-headed Door; and Fig. III. shews the Effect with a square-headed Door. The Intercolumnation *f b*, Fig. II. is 6 diam. and the Aperture 4 diam. the Height *g h* divided into 3 Parts, the upper 1 at *i* is the Center of the Arch: So likewise in Fig. II. the Intercolumnation *b q* is 6 diam. and the Aperture 4; therefore, the Diameter of a Door being given, divide it into 4, and take 1 for the Diameter of the Column, and then proportion the Order according to any Master, as required.

Note, in making circular-headed Doors, that the Impost be always above the common Height of a Man, *viz.* 6 Feet. *Note* also, that the Height of Doors and Gates be not less than twice their Breadth, nor more than twice and one sixth Part.

Plate XLV. *Divers Compoſitions of* Block Cornices *examined, with the Manner of proportioning them to the Height of any given Building: (A Work entirely new.) Alſo, Mr.* GIBBS'*s erroneous Method of placing* Cornices *over* Ruſtick Quoins *of Buildings detected.*

BEFORE we can make Block Cornices fit for Buildings, we muſt know how to find their proportionable Heights, which Mr. *Gibbs*, nor any other Maſter, has yet thought neceſſary to teach. To effect this; (1) Divide the given Height into five equal Parts, then will the upper one be a Height made fit to receive a *Tuſcan* Entablature. (2) Divide the upper one into 7 equal Parts, and take the upper four for the Height of the Cornice required. Fig. I. II. and III. are various Deſigns (which differ in their lower Parts only, the *Cymatium* and *Corona* in every of them being the ſame) by Mr. *Gibbs*, of which the firſt is worthy of Regard; but the two laſt being of meaner Deſign, on Account of the ſmall trifling Members, on which his Blocks or Truſſes are placed; and eſpecially that of Fig. III. which are two numerous, they are therefore to be rejected. As the Aſtragal *q f*, Fig. I. cannot properly be ſaid to be a Part of the Cornice, it being to the Wall, the ſame as it is to the Shaft of a Column; therefore divide the Height of the Cornice *a f* into 6 equal Parts at *a*, *b*, *c*, *d*, *e*, *x*, and give to each Member its Height, as the proportional Semicircles expreſs. Make *f h* equal to $\frac{1}{3}$ of the Cornice's Height, and at that Height let the upper Ruſtick finiſh. Make *h i*, *i k*, &c. each equal to half *a b*, which is the Heights of the Ruſticks. The Breadth of each heading Ruſtick from the Upright of the Wall (not from its own, *viz.* from *o* to 15, muſt be equal to $\frac{2}{3}$ of the Height of the Cornice, (that is, to *a e*) and the Breadth of the ſtretching Ruſtick equal to the whole Height of the Cornice (that is, to *a f*) over which muſt ſtand the out Line of the 2d Block or Truſs of the Cornice, whoſe Breadth muſt be equal to $\frac{1}{3}$ of the Cornice's Height. The out Line of the 1ſt Block, or Truſs to the Cornice, muſt ſtand preciſely over the Upright of the Wall, and thereby hath a true Bearing, and its Breadth the ſame as aforeſaid: But when they are placed without the Perpendicular of the Wall, as in the lower Example, they have a falſe Bearing on the lower Members. Divide the Height of any Ruſtick, as 19 20, into 8 equal Parts, and take 1 for the Height of their champhered Edges. As theſe Cornices are generally uſed without Architrave and Freeze, they are therefore made with leſs Projection than is equal to their Height, as other Cornices generally are. As I have now done with the Diviſion of the Cornice and Ruſticks, I muſt now proceed to take Notice of a moſt ſurpriſing Error committed by Mr. *Gibbs*, and many other Perſons, in placing Cornices over ruſticated Walls, in Manner as follows, *viz.* Inſtead of ſpringing from the Upright of the Wall *n o*, Fig. I. they make the Height *n o* into a Sort of Faſcia or Band, carrying it out equal to the Upright of the Ruſticks, and from thence ſpring the Cornice, as is repreſented by the dotted Profile of the Cornice *w x y z q* 11, which brings the whole Cornice too forward, gives falſe Bearings to the Truſſes, and a clumſy Aſpect to the Whole. It is alſo very common, in the ruſticating of Pilaſters and Columns, to make the Face of the Ruſtick the Upright of the Shaft, and cut the Champherings into the Body of the Shaft. This is a monſtrous and ſtupid Abſurdity; for here, under a Pretence of ſtrengthening the Shaft, as Ruſticks will do, when they embrace it, it is weakened as much as the Depth of their Mitres or Champhers are cut in. Of this Kind of Ruſticks are thoſe ruſticated Brick Frontiſpieces on each Side the Church of *St. Paul, Covent-garden*, which, I think, were not long ſince beautified, either under the Direction, or at the Expence of the preſent *Earl of Burlington*: But ſurely, had his Lordſhip well examin'd their Architecture, he could not have avoided the ſeeing of this ſo viſible an Abſurdity; and inſtead of giving to them a new

new Cloathing of Plaſter in that maimed Condition, would have taken Pity, and order'd thoſe barbarous Wounds to have been healed up, as Mr. *Doddington* did thoſe monſtrous ruſticated Columns built at *Gunvill* in *Dorſetſhire*, under the Direction of Sir *John Vanbrugh*. The Ruſtick Piers before the Houſe of the preſent Lord Chancellor in *Lincoln's-inn-fields*, built under the Direction of Mr. *Jones*, Clerk of his Majeſty's Works at *Kenſington* Palace, is alſo another horrid Example of this Kind. There are alſo many other wretched Things of this Naure in and about *London*, which at preſent I omit.

FIGURES IV. and V. repreſent four Deſigns for Ruſtick Doors, every Side being a different Deſign: Thoſe of Fig. IV. are tolerable good for groteſque Buildings, but thoſe of Fig. V. are both monſtrous: For this great Maſter (as he's thought by ſome to be) has not been contented with breaking the natural Courſe of the Architrave, but of the Freeze alſo, which of themſelves, without the Ruſticks, would have made a good Frontiſpiece; beſides, the breaking of the Architrave into ſo many Parts, is a weakening (not a ſtrengthening) to the Whole, and therefore abſurd.

Plate XLVI. *Two Ruſtick Doors.*

FIG. I. is a Deſign of *Vignola's*, but not to be commended, he having deſtroyed the natural Courſe of the Architrave and Freeze, for the Sake of making the Key-ſtones monſtrouſly high and narrow. Fig. II. is a Profile of the Entablature to this Frontiſpiece, which for groteſque Edifices is very good. Fig. III. is another double Deſign for two Ruſtick Doors, by Mr. *Gibbs*, where you ſee he has now crept with his Key-ſtone into the Bed-mould of the Cornice, which is ſurpriſingly monſtrous. As to the Ruſticks on each Side, they are indeed of very pretty Invention, and would better become a Frontiſpiece to a Paſtrycook's Shop, than they do the Windows and Doors to the Church of St. *Martin in the Fields*, as being analagous to the ruſticated Edges of Paſties and Pies.

Plate XLVII. *The Geometrical Conſtruction of the principal Parts of the* Dorick *Pedeſtal, and of the Mouldings of its Baſe, by* CARLO CESARE OSIO.

I. *Let* $a\,i$, Fig. IV. *be the given Height of the Pedeſtal.*

PRACTICE. (1) Draw $i\,o$ of any Length at Right Angles to $a\,i$. (2) Draw $a\,o$, making an Angle of 30 deg. with the Line $a\,i$, interſecting $i\,o$ in o. (3) From the Point i, let fall the Perpendicular $i\,k$ on the Line $a\,o$, and from k draw $k\,n$ parallel to $a\,i$. (4) From n draw $n\,m$ parallel to $i\,k$, and from m draw $h\,m$ parallel to $i\,o$. (5) Biſect $e\,k$ in f, and through f draw $g\,l$ parallel to $h\,d$. (6) From l draw $l\,b$ parallel to $a\,o$, cutting $a\,i$ in b; then is $g\,i$ the Height of the Baſe, $g\,b$ the Height of the Die, and $a\,b$ the Height of the Cornice, as required.

II. *Let* $m\,c$, Fig. III. *be the given Height of the Pedeſtal's Baſe.*

PRACTICE. (1) Divide $m\,c$ into 5 equal Parts at the Points 5, 6, a 7, and give the lowermoſt 2 to the Height of the Sub-plinth, or Zoccolo, $a\,b\,c\,g$. (2) Draw $g\,c$ at Right Angles to $m\,c$, and $b\,a$ parallel thereto, both of Length at Pleaſure. (3) Make $c\,f$ equal to $a\,c$, alſo draw the Lines $c\,h$ and $f\,h$, making the Angle $f\,c\,h$ equal to 30 deg. and the Angle $c\,f\,h$ equal to 60 deg. and continue $h\,f$ out at Pleaſure towards e. (4) From h let fall the Perpendicular $h\,d$, and on d, with the Radius $d\,h$ deſcribe the Arch $h\,e$, cutting $h\,f$ in e. (5) Through the Point e draw the Line $g\,e\,b$ parallel to $a\,c$, which will determine the Projecture of the Zoccolo. (6) Thro' the Point m draw $k\,n$

at

at Pleasure parallel to $g\,c$, and from the Point a draw $a\,k$, making the Angle $k\,a\,m$ equal to 30 deg. (7) Bisect $k\,m$ in l, and draw $l\,s$, making the Angle $m\,l\,s$ equal to 30 deg. (8) From m let fall the Perpendicular $m\,t$ on the Line $k\,a$, cutting the Line $l\,s$ in o, from which draw $o\,r$ parallel to $k\,n$, for the Height of the Fillet. (9) From the Point of Intersection, made by the Lines $f\,s$ and $m\,c$, draw a Line to n, making an Angle of 45 deg. and draw $n\,r$ parallel to $m\,c$, which will determine the Projecture of the Fillet $m\,n$. (10) From t draw $t\,w$ parallel to $k\,n$, cutting $m\,c$ in the Point 9, then will 8 9 be the Height of the Torus. (11) Bisect 10 a in 4, and draw 4 s perpendicular to $k\,a$, cutting $l\,p$ in s, from whence draw $s\,r$ parallel to 8 9. (12) Bisect $r\,s$ in q, the Center of the Torus. (13) Make 9 w and $v\,x$ each equal to 9 v, and draw the pricked Line $w\,x$. (14) Make $x\,z$ equal to $w\,x$, and draw the Line $w\,z$, which bisect in y, and then describe the Cima $a\,y\,z$. (15) Make a 2 equal to $v\,z$, and bisect 2 b in the Point 3. (16) Make z 1 equal to 2 3, and draw the Line 1 3, which completes the Projections of the Members in the Base as required.

FIG. I and II. demonstrate, how from a Man's Body the Circle and Square were first taken, of which I have already taken Notice.

Plate XLVII. *The Geometrical Construction of the Die and Cornice of the* Dorick *Pedestal, as also of the* Dorick *and* Attick *Base, by* CARLO CESARE OSIO.

I. *The Height of the Die to the* Dorick *Pedestal,* Fig. I. *being given, to find its Diameter: Together with the Height and Projection of its Fillet at Bottom.*

Let the given Height be $i\,s$.

PRACTICE. (1) Bisect $i\,s$ in n, and on n, with the Radius $n\,i$, describe the Circle $l\,m\,q\,r$. (2) Draw $o\,p$ through n at Right Angles to $i\,s$. (3) Divide the Quadrants $o\,i$ in l, $i\,p$ in m, $p\,s$ in r, and $s\,o$ in q. (4) Thro' the Points $i\,s$ draw the Lines $k\,h$ and $t\,v$ parallel to $o\,p$; also, thro' the Points $l\,q$ and $m\,r$, draw the Lines $h\,v$ and $k\,t$ parallel to $i\,s$, intersecting the former in the Points o, k, v, t, thereby completing the Body of the Die, as required.

To describe the Fillet $x\,y$ at its Bottom.

(1) CONTINUE $t\,v$ to z, making $s\,z$ equal to $n\,s$. (2) Make the Angle $w\,s\,z$ equal to 30 deg. and the Angle $w\,z\,s$ equal to 60 deg. and from w, the Point of Intersection, draw $w\,y$ parallel to $h\,v$, then will $x\,v$ be the Projection of the Fillet. (Let $d\,f$ represent $v\,x$ and $c\,e$, Part of $h\,v$, which being larger, the Manner of the Operation is more intelligible.) (3) Make $f\,g$ equal to half $f\,d$, and draw $g\,e$ parallel to $f\,d$, also join $f\,g$, and then is the Fillet completed, with its Height and Projection required. (4) Continue $y\,f$ to a, making $f\,a$ equal to $f\,d$, and then on f, with the Radius $f\,d$, describe the Hollow $f\,b$, which completes the Whole, as required.

II. *The Height of the Cornice to the* Dorick *Pedestal,* Fig. II. *being given, to divide it into its several Mouldings.*

Let $a\,n$ be the given Height.

(1) THRO' a draw $c\,b$ at Right Angles to $a\,n$, as also $n\,k$ through the Point n. (2) Make the Angles $c\,n\,a$ and $k\,a\,n$ each equal to 30 deg. (3) Bisect $c\,f$ in d, from whence draw d 2 parallel to $b\,c$, also bisect $f\,n$ in i, and from k, thro' i, draw $k\,i$, continuing it till it meet $a\,n$ in x, (4) From x draw $x\,g$, and from i draw $i\,t$ parallel to $a\,b$, and of any Length at Pleasure. (5) From c, thro' b, draw $c\,w$, and from d draw $d\,e$ parallel to $a\,n$, then from

from *e* draw the Line *e* 4, and from *w*, the Line *w* 1, and thus are the Heights of every Moulding determin'd.

To determine the Projectures.

(1) Make *ab* equal to *a n*, and from *b*, draw *b* 4 parallel to *a n*, which will determine the Fillet. (2) Make 4 3 equal to ½ *b* 4; alfo 3 6 equal to *ed*, and on the Point 6, defcribe the Ovolo 3 2. (3) Continue 6 2 to 1, then is the Fillet under the Ovolo done. (4) Make 9 *g* equal to *x* 9, and thro' the Point *g* draw the Line 7 *t* parallel to *a n*; then continuing 2 1 to *y*, making 1 *y* equal to 1 *z*, on *y*, with the Radius *y* 1, defcribe the Arch 1 8, which completes the Face of the Corona. (5) Bifect 9 *g* in *o*, make *q t* equal to *o g*, and draw *o q*; alfo bifect *q t* in *s*, and on *q* defcribe the Arch *o s*, which completes the Drip. (6) Make *x l* equal to *p* 10, and draw *l p* the lower Fillet. (7) Make *n m* equal to half *l p*, and defcribe the *Cima reverfa*, which completes the whole Cornice as required.

III. *The Height of the* Dorick *Bafe*, Fig. IV. *being given, to divide it into its feveral Mouldings.*

Let b y be the given Height.

PRACTICE. (1) Bifect *by* in *u*, and draw *xw* and *yz* at Right Angles to *by*, and of any Length at Pleafure; then will *xy* be the Height of the Plinth. (2) Draw *a c* parallel to *w x*; alfo draw *a x*, making the Angle *axb* equal to 30 Degrees. (3) On *a*, with any Radius, defcribe an Arch, as 3 1, which divide into 2 equal Parts at 2, and draw the Line *a* 2 4, from whence draw the Line 4 *n* parallel to *w x*, then will 4 *x* be the Height of the Torus. (4) Bifect 4 *x* in *o*, and from *o* draw the Line *o t*, parallel to *w x*, of any Length at Pleafure. (5) From 6 let fall the Perpendicular *b d* on the Line *a* 4, and from *d* draw the Line *d i*, cutting *by* in *f*; make *e f* equal to *f* 4, and from *e* draw the Line *e g*, parallel to 4 *n*: And thus are the Heights of every Moulding determin'd.

To determine their Projectures.

1) DRAW the Line *f c*, making an Angle of 45 Degrees with the Line *f b*, which will cut *b c* in *e*, then drawing *c g* parallel to *b e*, the Cincture or Fillet is completed. (2) Continue *c g* to *q*, bifect *o q* in *p*, and make *q r* equal to *p q*, and draw *l r* parallel to 4 *o*. (3) Make *k h* equal to *k l*, and draw *h l*, cutting *f i* in *i*, the Center of the Aftragal. (4) Make *x w* equal to *e x*, and draw *e w*, which will cut *o t* in *s*, the Center of the Torus. (5) From *w* draw *w z* parallel to *x y*, until it meet *z y* in *z*, and then is the Bafe completed as required.

IV. *The Height of the* Attick *Bafe being given*, Fig. III. *to divide it into its Mouldings, with their Projectures.*

Let a 6 be the given Height.

(1) BISECT *a* 6 in *t*, and from thence draw the Line *t c*, making the Angle *a t c* equal to 30 deg. (2) Draw *a c*, and 7 6, at Right Angles to *a* 6, and of any Length at Pleafure. (3) Bifect *t c* in *g*, and on *g* raife a Predendicular, which will cut *a* 6 in *m*; then will *a m* be the Height of the upper Torus. (4) From *m* draw *m e* parallel to *a* 6, alfo, thro' the Point *g*, draw the Line *b y* parallel to *a* 6, which will cut *m e* in *e*. (5) Bifect *b e* in *d*, the Center of the upper Torus; alfo, bifect *g e* in *f*, and, making *m o* equal to *e f*, draw *o f*, the Fillet under the upper Torus. (6) From the Point *m* draw the Line *m s* parallel to *t c*, and at *t* let fall the Perpendicular *t s* on the Line *m s*, and from the angular Point *s* draw the Line *s* 8 1, which is the upper Part of the lower Torus. (7) Bifect *m* 8 in *p*, and from *p* draw *p q*, making the Angle *q p* 8

 equal

equal to 60 deg. which Line continue until it meet *m s* in *q*. (8) Draw the Line *q y* cutting *a* 6 in *r*, through which Point draw *r z* parallel to 8 1, which is the Height of the lower Fillet. (9) Make the Angle 8 *s* 5 equal to 60 deg. then will *s* 5 cut *a* 6 in 5, then 8 5 is the Height of the Torus, and 5 6 the Height of the Plinth. (10) Bisect 8 5 in *v*, and draw *v* 2 the central Line of the Torus. (11) Make 4 5 equal to *m* 5, and draw the Line *m* 4 cutting *v* 2 in 2, the Center of the lower Torus. (12) Make 7 6 equal to 4 5 and join 4 7, which completes the Plinth. (13) From *f* draw *f z* parallel to *m* 4, cutting *r z* in *z*, and *m e* in *h*, and draw *z* 1 parallel to *a* 6, which completes the Projecture of the Fillet. (14) On the Point 2, with the Radius 2 3, describe the lower Torus. (15) Draw *h w* parallel to *e y*, and bisect *h z* in *k*, from which Point draw the Line *n k* parallel to *r z*. (16) Make *n i* equal to *l n*, then the Point *i* is the Center of the Arch *f n*, and the Point *k* is the Center of the Arch *n x*, which together form and complete the Scotia: And thus are all the Mouldings completed as required.

Plate XLIX. *The Geometrical Construction of the* Attick *Base, according to* L. B. ALBERTI; *and the Cincture and Astragal to the* Dorick *Shaft, by* CARLO CESARE OSIO.

I. *To describe the* Attick *Base according to* Leoni Baptista Alberti.

Let b p be the given Height.

PRACTICE. (1) Through the Extreams *b p* draw the Lines *g b* and *z p* at Right Angles, and of Length at pleasure. (2) Draw *b m* until it meet *z p*, being continued in *m*, making the Angle *m b p* equal to 30 deg. (3) Divide the Angle *b m p* into 2 equal Parts by the Line *m n*, which continue until it meet *b p* in *n*, then is *n p* the Height of the Plinth, and therefore from *n* draw *n y* of any Length parallel to *p z*. (4) From *n* draw *a n*, making the Angle *t n b* equal to 30 deg. also draw *a b*, making the Angle *a b n* equal to 60 deg. and from *a*, their Point of meeting, draw *a d i* parallel to *b g*, then will *b d* be the Height of the upper Torus. (5) Bisect *b d* in *c*, and from *c* draw *c f* parallel to *b g*, which is the central Line of the Torus; also bisect *t n* in *o*, and from *o* draw *o v*, the central Line of the lower Torus. (6) Bisect *d t* in *l*, make *b g* equal to *b l*, and draw *l g*; also make *o v* equal to *b g*, and draw *g v*. (7) Bisect *l g* in *i*, and through *i* draw *e k* parallel to *b p*, cutting *c f* in *f*, the Center of the upper Torus. (8) From the Point *h*, where *g l* cuts *i d*, draw *h q* parallel to *a n*, intersecting *e k* in *k*; from whence draw 2 *k* parallel to *d i*, and then is that Fillet completed. (9) Make *l s* equal to *l* 2, and draw *f q* intersecting *k q* in *q*, and joining *q r*, that Fillet is also completed.

To describe the Scotia.

(1) MAKE *h i* equal to *i k*, and from *h* draw *h* 5 parallel to 2 *s*, which divide into 4 equal Parts, at the Points 3, 6, 7. (2) From the Point 3 draw the Line 3 1 2 parallel to *b g*; also, from the Point *q* draw the Line *q* 2 parallel to *b p*, intersecting the Line 3 2 in the Point 2; then is the Point 1 the Center of the Arch *k* 3, and the Point 2 the Center of the Arch 3 *q*, on which describe the *Scotia* required. (Lastly) On the Center *f*, with the Radius *e f*, describe the upper Torus; and on the Center *v*, with the Radius *v w*, describe the lower Torus; and then will the whole Base be completed as required.

II. *The Height of the* Dorick *Column*, Fig. I. *being given, to divide off the Heights of the Base and Capital.*

Let a g be the given Height.

PRACTICE. (1) Bisect *a g* in *c*, from whence draw *c d*, making an Angle of 30 deg. also from *g* draw *g d*, making an Angle of 60 deg. with the Line *a g*, which

which continue until it meet *c d* in *d*. (2) Bisect *g d* in *e*, from whence draw *e f*, perpendicular to *a g*. (3) Make *a b* equal to *f g*, then *a b* will be the Height of the Capital, *f g* the Height of the Base, and *b f* the Height of the Shaft.

III. *To proportion the Cincture to the Shaft of the* Dorick *Column.*

Let c d, Fig. IV. *be the Semidiameter of a Column, and b d the central Line.*

PRACTICE. (1) Draw the Line *d p* of any Length, making the Angle *p d o* equal to 30 deg. also draw the Line *c p*, making the Angle *p c a* equal to 30 deg. intersecting each other in the Point *p*; from which let fall the Perpendicular *p o* on the Line *d c*, being continued to *o*. (2) From *o* draw *o k*, making the Angle *k o c* equal to 30 deg. which continue until it meet *p c* in *k*, from whence draw *f l* parallel to *c o*, also draw *k m* parallel to *a c*. (Lastly) On *k* as a Center, with the Radius *k l*, describe the Arch *l h*, and from *h* draw *h q* parallel to *d m*, which will complete the Cincture as required.

Note, That the most ready Way of describing an Angle of 30 deg. is to open the Compasses to any Distance, as *d e*, and describe an Arch, as *f e*, on the Point *d*: This done, set up the same Opening from *e* to *f*, on which Points, with the same or any other Opening, describe Arches intersecting in *g*; then a Line drawn from *d* thro' *g* will make an Angle of 30 deg. with the Line *d m*.

IV. *To proportion the Astragal to the* Dorick *Shaft, the Projection being given.*

Let a c, Fig III. *be equal to the Projection given.*

PRACTICE. (1) Make *a g* equal to *a c*, and draw *g c*, which bisect in *e*, from whence draw *e l* parallel to *a k* of Length at pleasure. (2) Divide *g c* into 3 equal Parts at *f d*, and through *f* draw *m n* parallel to *a c*; also from *g* draw *g i* parallel to *m n*, cutting *e l* in *h* and *i*, and completing the Fillet. (3) The Point *d* is the Center of the Astragal, therefore on *d*, with the Radius *b d*, describe the Astragal *b o n*. (Lastly) Continue *h i* to *l*, and make *i l* equal to *g i*; then on the Point *l*, with the Radius *i l*, describe the Hollow or Arch *i k* under the Fillet, which completes the Astragal required. *Note*, In this Example the Height and Projecture are equal; but in the following the Height is but $\frac{3}{4}$ of the Projection.

V. *To proportion the* Dorick *Astragal,* Fig. V. *with its Fillet, so that its Height shall be but* 3 *fourths of its Projection.*

Let a i be equal to the given Projection.

PRACTICE. (1) Make *i m* equal to *a i*, and draw *a m*, which bisect in *h*, through which draw *k d* parallel to *a i*; also bisect *a h* in *b*, the Center of the Astragal, from whence draw *c g* parallel to *i n*. (2) Bisect *k m* in *l*, and from *l* draw *l f* parallel to *k d*, cutting *c g* in *f*. (3) On *b*, with the Radius *b d*, describe the Astragal *o p d*, and making *f g* equal to *f l*, on *g*, with the Radius *f g*, describe the Arch *f n*, which completes the Whole as required.

VI. *To proportion the Astragal,* Fig. VI. *with lesser Height and Projection than the former.*

Let e b be the given Height.

PRACTICE. (1) Draw *k e* at Right Angles to *e b*, and divide *e b* into 3 equal Parts at *d c*, make *b a* equal to *c b*, and draw the Line *k a*, which bisect in *h*, and from thence draw *h c* parallel to *k e*. (2) From *b* draw *f b* parallel to *h c*; also from *b* draw *b i* parallel to *a k*, then bisect *e c* in *d*, and from *d* draw *d i* parallel to *k e*, cutting *b i* in *i*, the Center of the Astragal. (3) From *g* draw *g f*, the Face of the Fillet, parallel to *a e*, and on *i*, with the Radius *i b*, describe the Semicircle *l h*, which completes the Astragal as required.

Plate

Plate L. *The Geometrical Construction of the* Dorick *Capital and Entablature, by* CARLO CESARE OSIO.

I. *The Height of the* Dorick *Capital*, Fig. IV. *being given, to describe its Mouldings.*

Let i 7 be the given Height.

PRACTICE. (1) Divide *i* 7 into 3 equal Parts at *p v*, and draw *f p* and 2 *v* at Right Angles to *i* 7 of Length at pleasure. (2) Make *p f* equal to *p v*, and draw *f v*; bisect *p v* in *q*, *q v* in *s*, *q s* in *r*, and *s v* in *t*, and from the Points *r*, *s*, *t*, draw the Lines *w r*, *x s*, *y t*, at pleasure, parallel to *f p*. (3) From the Points *w*, *z*, 1, draw the Lines *w x*, *z y*, 1 2, parallel to *r v*, which will complete the Annulets. Continue 1 2 to 3, the Center of the Hollow 2 4. (4) Draw *o r*, making the Angle *o r p* equal to 30 deg. meeting *f p* in *o*; also draw *o n* and *n p*, making the Angles *n o p* and *n p o* each equal to 30 deg. intersecting each other in *n*, the Center of the Ovolo, on which, with the Radius *n w*, describe the Ovolo *w g*. (5) From *o* draw *o h* parallel to *i p*, make *p m* equal to *p r*, and from *m* draw *m d* at pleasure; make *h a*, the Projection of the Abacus, equal to *h o*, and draw the Diagonal *a o* cutting *d m* in *e*, from whence draw *e f* parallel to *m p*. (6) Divide *i m* into 3 equal Parts at *k l*, and from *k* draw *k b*, parallel to *a i*, at pleasure. (7) Draw *a b* parallel to *i k*, to complete the Fillet. (Lastly) Make *b c* and *d e* each equal to half *a b*, and draw the Line *c d*, on which describe the Cima Reversa: And thus are all the Parts of the Capital determined.

To delineate the Astragal.

(1) BISECT *v* 7 in 5, make 7 6 and 7 18 each equal to 5 7, and draw the Diagonal 6 18, which bisect in 10, through which draw 9 12. (2) Bisect 6 10 in 8, the Center of the Astragal; also 8 10 in 11, from whence draw 11 14 parallel to 7 17; also bisect 12 18 in 16, and from 16 draw 16 13 parallel to 12 9, cutting 10 14 in 13, and thereby completes the Fillet. (Continue 10 13 to 14, making 13 14 equal to 13 16.) (Lastly) On 8, with the Radius 8 9, describe the Astragal; and on the Point 14, with the Radius 16 13, describe the Arch 13 15, which completes the Whole as required.

II. *To describe the* Dorick *Entablature*, Fig. I. II. III.

Let a X be the given Height equal to 1 fourth Part of the Column's Height.

PRACTICE. (1) Draw the Line *a* Z, making the Angle X *a* Z equal to 30 deg. and the Line XZ, making the Angle *a* XZ equal to 60 deg. intersecting *a* Z in Z, from whence draw ZB perpendicular to *a* X, then will B X be the Height of the Architrave. (2) Bisect *a* B in *b*, then will *b* B be the Height of the Freeze, and *a b* the Height of the Cornice. The principal Parts of the Entablature being thus found, I will now proceed to the Divisions of their Parts, of which the Architrave is the first in Order.

Let a X represent the central Line of the Column, and b X is the given Height of the Architrave.

PRACTICE. (1) Draw the Line 13 X, making the Angle B X 13 equal to 30 deg. cutting B 10 in 13. (2) Bisect B 13 in *a*, and from *a* draw *a* C, making the Angle B *a* C equal to 30 deg. and cutting BX in C; then is BC the Height of the Tenia or Band, and therefore from C draw C 5 at pleasure parallel to B 9. (3) Bisect X 13 in *z*, from whence raise the Perpendicular *z y*, cutting BX in *y*, then is C*y* the Height of the Drops with their Fillet. (4) Make C 7 and X 13 each equal to CX, and draw 13 7 continued until it meet B 9 in 8; make the Projection of the Tenia 9 8 equal to 3 fourths of its Height

Height 8 7, and draw the Line 9 5 for the Face of the Tenia. (5) Make the Projections of the Gutta 1 12 11 equal to half the Height of the Tenia. (6) Make 4 3 equal to ⅙ of 8 7 for the Height of the Fillet: And thus are the Parts of the Architrave determined. The Gutta's or Drops *l*, *m*, *p*, *q*, *t*, *w*, *y*, altho' belonging to the Architrave, will be better described with the Triglyph in the Freeze, which now comes next in Order.

Let b B *be the Height of the Freeze.*

PRACTICE. (1) Divide *b* B into 3 equal Parts at *c d*, and make B 9 *o* equal to *c* B, and draw 90 91, which will be the Bounds or Limits of the Semi-triglyph. (2) Divide B 90 into 6 equal Parts at the Points *g*, *f*, *e*, *d*, *c*, and from thence draw the Lines *g* 1, *f* 2, *e* 3, *d* 3, and *c* 5, parallel to *b* B. (3) Make 91 11 equal to 5 91, or ½ Part of the Semi-triglyph's Breadth, and draw the Line 11 7 parallel to 91 *b*; also make 11 12 and 8 9 each equal to 10 11, or ⅙ Part, and draw the Lines 6 9, 13 9, and 10 12, which will complete the Semi-triglyph as required. (4) The Line *c* 90 being drawn, and intersected in the Point K by the Line 2 *f*, from thence draw K L parallel to B 90, cutting 91 90 in the Point L. (5) Make 90 8 equal to 90 L, and from the Point 8 draw the Face or Upright of the Freeze, which is also in the same Plane with the Upright of the Face of the Architrave.

Note, The same being performed, on the other Side of the central Line, will complete a Triglyph entire.

UNDER the Tenia of the Architrave are placed 6 *Gutta's* or Drops in such manner, as if they had flowed from the Channels of the Triglyph thro' the Tenia and Fillet under it, therefore seem to be an Ornament belonging to the Triglyph; and indeed, when the Triglyphs are omitted, as oftentimes they are, these Gutta's are omitted also; wherefore 'tis evident, that tho' they are placed in the Architrave, yet are a Part belonging to the Triglyph only. Their Forms are twofold, being made by some as the Frustums of a Semi-pyramis; and by others, as the Frustum of a Semi-cone, cut from their Vertexes, down their Axises, perpendicularly unto their Bases.

The Manner of describing them is as follows.

PRACTICE. (1) Continue down the Lines 91 90, 5 *c*, 4 *d*, 3 *e*, 2 *f*, and 1 9, towards X 13. (2) The Line X 13 being before drawn, make the Angle B X 13 equal to 30 deg which bisect in *z*, and from thence raise the Perpendicular *z y*, cutting BX in *y*, from whence draw *y* 12, parallel to X 13, for the Depth of the Gutta's, intersecting the aforesaid continued Lines in the Points *l*, *m*, *p*, *q*, *t*, *w*. (3) Draw the Diagonals *y h*, C *t*, *h p*, *t i*, *i l*, *k p*, intersecting D 3 in the Points *n*, *o*, *r*, *s*, *v*, *x*. (Lastly) Draw the Lines *x y*, *v t*, *s t*, *r p*, *o p*, *n l*, and then *v t x y*, *r p s t*, and *o p n l*, will be the Profiles or Sections of the Gutta's to the Semi-triglyph, as required.

THIS Ornament, with the Triglyph over it, has a very agreeble Effect; and therefore Workmen are fond of introducing it, without considering what it represents, or whether 'tis agreeable to the Frontispiece they make, which is entirely wrong: For, as they were first used in the *Delphic* Temple, to represent an *Antique Lyre*, which Instrument *Apollo* had been the Inventor of; they cannot therefore be a proper Ornament to every Building, any more than the Ox-skulls placed in the square Intervals, or Metops between them, which th Antients introduced, alluding to their Sacrifices, *&c.* with which we are entirely unacquainted: And therefore, instead of such Ornaments, we should introduce such as allude to the Situation of the Place, or Person, to whom the Building belongs. Having thus gone through the Architrave and Freeze, there is now the Cornice only remaining.

Let a b, Fig. I. *be the given Height.*

PRACTICE. (1) Bisect *a b* in *c*, also *c b* in 2, make 2 *d* equal to ⅓ of 2 *b*,

and from the Points *c*, 2, *d*, draw Lines parallel to each other, and at Right Angles to *a b*, of Length at pleaſure. (2) Make the Angle *d b h* equal to 30 deg. biſect *b h* in *c*, and draw *k c* at Right Angles to *b h*, cutting *d b* in *k*, from whence draw *k v* at pleaſure. (3) Make *k v* equal to ¼ of *k b*, and from *v* draw *v w* at pleaſure. (4) Continue up the Face of the Freeze to 48, cutting the Line *d z* in G, make G *x*, I *v*, each equal to G I, and draw the Line *x v w*, then *v w* terminates the Fillet. (5) Divide I *v* into 3 equal Parts, and draw the Projection of the Capital to the Triglyph; alſo on *x*, with the Radius *x v*, deſcribe the Ovolo *v z*. (6) From *d* in the central Line draw the prick'd Line *d* 38, making the Angle *c d* 38 equal to 30 deg. alſo from the Point *c* draw the Line *c* 38, making the Angle *d c* 38 equal to 60 deg. cutting *d* 38 in 38, through which draw the Line E 38 39. (7) Biſect *a c* in *e*, and from *c* draw the Line 43 *c* in an Angle of 30 deg. alſo from *e* draw the Line *e* 43 at Right Angles to 43 *c*; and through the Point 43 draw the Line 44 49; as likewiſe from *e* draw the Line *e* 51. (8) Make 46 *c* equal to ¼ of *a c*, and the upper Fillet to one fourth of *a c*. (9) From the Point 2, on the central Line, draw the pricked Line 2 4; alſo make *z y* equal to ½ 2 *d*, and draw *y* 6 parallel to the central Line. (10) Continue *y* 6 to 7, making 6 7 equal to 6 *y*, and from the Point 7 draw the Line 7 A parallel to 6 4. (10) Take the Diſtance *x w* in your Compaſſes, and ſet it on the Line 7 A ſix times, as from 8 to 10, 11, 12, 13, 14, 15, and on thoſe Points, with the Radius 7 8, deſcribe the ſeven Semicircles, interſecting each other in the Points 16, 17, 18, 19, 20, 21, 22, 23, and the Line 7 A in the Points 7, 8, 10, 11, 12, 13, 14, 15 A, through the Points 16, 8.

(12) Through the Points	draw the Line	cutting the Line 6 4 in	and the Line 2 5 in
16 8	16 25	*b*	25
17 8	17 24	*a*	24
17 10	17 *a*	*d*	*d*
18 10	18 26	*c*	26
18 11	18 28	*f*	28
19 11	19 27	6	27
19 12	19 30	*h*	30
20 12	20 29	*g*	29
20 13	20 32	*k*	32
21 13	21 31	*i*	31
21 14	21 34	*m*	34
22 14	22 33	*l*	33
22 15	22 *o*	*o*	
23 15	23 35	*n*	35

then will the Lines *a* 24, *b* 25, *c* 26, *d a*, *e* 27, *f* 28, *g* 29, *h* 30, *i* 31, *k* 32, *l* 33, and *m* 34, form the Profile of the *Gutta's*, in the *Plancere* of the Corona. (13) Draw *o* 36 at Right Angles to *d* 5; alſo divide *o* 4 in 37, and deſcribe the ſmall Semicircle for the Drip. (14) From the Point 4 draw the Line 4 42, parallel to the central Line, for the Face of the Mutile. (15) Divide 42 43 into 3 equal Parts, and make 41 39 equal to one of thoſe Parts. (16) Make 42 *a* equal to 42 41, draw *a* 39, and deſcribe the *Cima reverſa*; alſo make *a* 40 equal to 41 39, and draw the Line 40 49 for the Face of the Corona. (17) Make the Projections of the *Cima reverſa* and *Cima recta* each equal to their Heights, and that will complete the Whole as required.

R E M A R K.

THIS Geometrical Conſtruction of the Orders may probably have been the very firſt Method uſed, as CARLO CESARE OSIO doth affirm, and in which there is a great deal of Pleaſure, in conſidering with what great Difficulty thoſe Rules have been acquired, and how ſurpriſingly, in many Caſes, the Proporti-

ons

ons of one Member to the other is produced: Yet upon the Whole, I cannot think it to be ſo good a Method for a young Beginner, as many others comprifed in this Work; and therefore to ſuch, it will be better to read this Maſter, after they have well acquainted themſelves with others more eaſy. But, becauſe I give this early Admonition, don't let it be an Excuſe not to read this Maſter at all: For if that ſhould be the Caſe, they will deprive themſelves of many beautiful Proportions, and fine Methods of Working, not to be ſeen in any other Maſter.

The Manner of fluting Pilaſters and Columns.

THE Flutings of Columns do particularly affect the *Ionick* Order (rarely the *Dorick* ſaith *Evelyn*) *uti Stolarum Rugæ*, in Imitation of the Plaits of Women's Robes, as *Vitruvius* ſaith. The firſt Order that the Antients fluted was the *Ionick*, in that renowned *Temple of Diana*, built at *Epheſus* (as many think) by the *Amazons*, which employed above two hundred Years to finiſh, at the Expence of all *Aſia*, whoſe Columns were of Marble 70 Feet in Height; of which more hereafter, when I come to ſpeak of the *Ionick* Order. As this Temple was built after that immemoriable magnificent Temple, erected to the Goddeſs *Juno*, in the famous City of *Argos*, by *Dorus*, Prince of *Achaia*, and Sovereign of *Peloponneſus*, it therefore ſeems, as if the Original *Dorick* Columns were not fluted, but made plain: Not but the Alluſion may be made as well to the Goddeſs *Juno*, as to the Goddeſs *Diana*. But however, we find many Inſtances of fluted Columns among the antient *Dorick* Buildings of *Rome*, as in the Theatre of *Marcellus*, Plate LI. the Bath of *Diocleſian*, Plate LVII. *&c.* and therefore thoſe Examples may be pleaded as Authority to do the ſame when required.

The antient Manner of fluting the Dorick Shaft was, to divide its Circumference into 20 equal Parts, (as Fig. I. which is a Semicircle divided into 10 Parts.) The Depth of each Flute was equal either to the Segment of a Circle on the Side of a Geometrical Square, as *l b* 10, where the Breadth of the Flute is the Side of the Square; or otherwiſe, to a Segment of a Circle on the Side of an Equilateral Triangle, as *n* A 1, on the Side of the Equilateral Triangle *n o* 1; which Flutings had no Diviſions of Fillets, (as are in the other Orders) but were worked to ſharp Edges or Angles, without any Spaces of Fillets between. I will not undertake to aſſign the Reaſon, why the Antients did thus flute their *Dorick* Shafts; but ſure I am, that they are abundantly more liable to Abuſe and early Decay, than they would be, were each Flute divided by a Fillet, which would be a Strengthening, and an Ornament to them alſo. To diſtinguiſh the *Dorick* Fillets from the *Ionick* Fillets, divide the Breadth of each 20th Part into 5 equal Parts, give 1 to each Fillet, and 4 to each Flute.

To flute the Ionick, Corinthian, *or* Compoſite *Columns.*

(1) DIVIDE the Baſe of each Column into 24 equal Parts, and divide each Part into 4; give 1 to each Fillet, and 3 to each Flute, as in Fig. III. (2) If from the ſeveral Diviſions of the Flutes and Fillets, you draw Right Lines at Right Angles to the Diameter, their parallel Diſtances will repreſent the Breadth, that every Flute and Fillet will be ſeen to diminiſh, from the Middle to both Sides of the Column.

To divide the Flutes and Fillets on the Shaft of a plain Column.

(1) DRAW a Right Line, as *a b* (in the lowermoſt Figure of the Plate) of Length at pleaſure, and therein aſſume a Point, as *b*. (2) Open your Compaſſes to any ſmall Diſtance, ſo that 24 of thoſe Diſtances, ſet along the Line *a b*, ſhall be leſs than the Girt of the Column at its Aſtragal. This done, divide the Opening of the Compaſſes into 4 equal Parts, and take 3 of them into your Compaſſes; alſo take the other 1 into another Pair of Compaſſes, and then will

will the one be the Breadth of a Flute, and the other the Breadth of a Fillet. With these Openings, prick along the Line *a b* 24 Flutes, and as many Fillets; and from those Points draw Right Lines, parallel to each other, and at Right Angles to *a b*. (3) Take the exact Girt of your Column with a ſtrait Piece of Parchment, &c. which ſuppoſe to be *d c*; and then laying its Ends, ſo as to touch the two Out-lines *e a* and *f b*, the ſeveral parallel Lines will divide its Edge into its proper Flutes and Fillets, as at the Points 1, 2, 3, 4, 5, 6, 7, &c. (4) Apply one End of your Parchment, thus divided, unto a Right Line drawn on the Shaft, from its Aſtragal to its Cincture, and therewith girt the Shaft at its Bottom, and from the ſeveral Points on its Edge, prick off the Breadth of every Flute and Fillet, as required. (5) Take the Girt of the Column at its Aſtragal, and apply it to the Out lines, as before, which ſuppoſe to be *e f*, then the Edge will be divided, with its Flutes and Fillets proportionably diminiſhed; and if one End be placed to the aforeſaid Right Line, drawn on the Surface of the Column, (not under the Aſtragal) and the Breadths of every Flute and Fillet be pricked off from the Papers Edge; when 'tis girded about the Neck of the Column, as before at the Bottom, proceed to draw Right Lines, from the Diviſion of the Flutes and Fillets above, to thoſe below, and you will divide the Superficies of the Shaft ready for working, as required. *Note*, by the ſame Rule you may find the Breadth of the Flutes and Fillets, in any Part of the Shaft you are pleaſed to girt it at.

To flute Pilaſters.

SOME Architects divide Pilaſters into 9 Flutes and 10 Fillets, and others but into 7 Flutes and 8 Fillets, of which the laſt is moſt generally practiſed. As the Breadth of a Fillet is one third Part of a Flute, therefore divide your Pilaſter, if for 9 Flutes, into 37 equal Parts, but if for 7 Flutes, into 29 equal Parts, and then give 1 to each Fillet, and 3 to each Flute. Sometimes Workmen place a Bead at the Angle of Pilaſters, as in Fig. II. and then the Breadth muſt be divided into 31 equal Parts; give 3 to each Flute, 1 to each Fillet, and 1 to the quarter Round, or Bead, at each Angle, as in the Figure expreſſed. But this laſt Method is not to be commended, becauſe the breaking of the Angles by the Beads is a ſeeming Diminution of their Breadth, and indeed it makes the Angles look weak, by being divided into ſmall Parts, which otherwiſe would be more maſſy, and conſequently much ſtronger, and of grander Aſpect.

Note, That Flutings are called by ſome *Striges*, and Fillets *Striæ*, *Raies*, or *Liſts*.

Note alſo, that the Flutings of Columns and Pilaſters are generally filled up with a Swelling, a third Part from the Baſe, called Staves, or Cablings.

P. *Pray, wherein doth a Pilaſter differ from a Column?*

M. A Pilaſter hath no other Difference from a Column, than that the Shaft of a Column is round, and diminiſhed from a third Part of its Height unto the Aſtragal; and that of a Pilaſter is ſquare, and ſhould never be diminiſhed (as erroneouſly is done by *Inigo Jones*, at the Banquetting-houſe at *White-hall*) but when it ſtands behind a Column: When a Pilaſter ſtands alone, 'tis called by the *Greeks Paraſtate*, and by the *Italians*, *Membretti*. The Projection of Pilaſters, from the Wall they ſtand in, is ſometimes a fourth, or fifth, or ſixth Part of their Diameter, as Occaſion may require; and the remaining Part of the ſquare Body is always ſuppoſed to be ſtanding within the Wall. From their Projecture, or Coming forward, they are alſo called *Ante*, or *Antæ*, as having been placed before the Walls of antient Temples, and at their Quoins, for Security and Strength. In the Uſe of Pilaſters 'tis to be obſerved, that tho' they have a noble Aſpect in large Buildings, yet in ſmall Fronts they make but a very poor Figure, and therefore in ſuch Buildings ſhould be avoided.

Plates

Plates LI. LII. *Two Examples of the* Dorick Order *in the Theatre of* MARCELLUS *at* Rome.

ALTHO' many Examples of the *Dorick Order* are given us, without any Baſe, as the 2d Example hereof, and that of the Bath of *Diocleſian*, Plate LVII. yet here we ſee, in this 1ſt Example, the *Attick* Baſe introduced, and I think not improperly: For if Columns were antiently uſed without Baſes, they were not ſo beautiful, nor had ſo good a Foundation, as thoſe with Baſes.

P. *Pray what is the* Attick *Baſe?*

M. THE *Attick* Baſe (or, as ſome call it, the *Attick Curgi*) conſiſts of a Plinth, two Torus's, and a Scotia, with its Fillets, as the Baſe to this 1ſt Example, and which exceeds the *Tuſcan* Baſe by the Scotia *y*, and the upper Torus *x x*.

P. *Pray why is the* Scotia *ſo called?*

M. FROM the *Greek* Σκοτία, *Scotos*, Darkneſs, or from its Obſcurity, proceeding from the Shade of its Hollowneſs, but more vulgarly (ſaith *Evelyn*) they call it *Caſement*; though, I muſt confeſs, I never heard of this Name before. It is alſo called by ſome *Trochile*, Τρέχω or Τρόχος, a *Rundle* or *Pullywheel*, which it reſembles. The *Italians* call it *Baſtone*.

BY the ſeveral Diviſions of equal Parts, and their Sub-diviſions, you ſee by Inſpection, how the principal and particular Parts are determined, and which, to conſider and find out, I have placed here as Examples for Practice; though indeed there is but very little in them, they being made ſo very plain, as to be underſtood at firſt Sight by thoſe who have made themſelves Maſters of the foregoing, and which any one may ſoon do with good Attention. I ſhall now proceed to give you my *Remarks* on theſe Examples: And *firſt*, I cannot believe the Annulets, in either of the Capitals, to be proportionable to the Ovolo, and Abacus next above them, they having a poor and weak Look, by being many and ſmall. This I cannot help calling an Error, (notwithſtanding that *Vitruvius*, *Palladio*, and ſome other Maſters have followed it) and which is evident, if we do but compare theſe, or any other of the aforeſaid Maſters, with *Scamozzi*, Plate LXII. and with Mr. *Gibbs*, Plates C. and CI. where the firſt hath a *Cima Reverſa*, and the latter a *Cavetto*, either of which have a much grander Look.

P. *Pray which are the* Annulets, *you ſpeak of?*

M. THOSE three ſmall Fillets or Rings immediately under the Ovolo of each Capital, compriſed between HK in the firſt Example, and *h k* in the ſecond. The Capitals of theſe Examples conſiſt of the ſame Members, but differ in their Magnitudes; the Ovolo of Example 1ſt being greater than that of the 2d, and the Abacus of the 2d greater than that of the 1ſt. The Architraves of both conſiſt of one *Faſcia*, and the *Gutta's* or Drops in both have a noble Aſpect. Theſe Gutta's are made either as Sections of Fruſtums of *Pyramiſes*, or of *Cones*, but ſquare at their Baſes; they are alſo under the *Planton* or *Plancere* of the Corona, as are expreſſed in the 2d Example, and contain 18 in Number, placed exactly over the Triglyphs in the Freeze.

P. *Pray what doth a* Triglyph *repreſent?*

M. AN *Antique Lyre*, firſt uſed in the *Delphic* Temple, of which Inſtrument, 'tis ſaid, *Apollo* was the Inventor. The Word, in *Greek* Τρίγλυφος, ſignifies a three-ſculptur'd Piece, *Quaſi tres habens Glyphos.* The *Italians* call them *Planetti*, ſmall Plains. Their Breadth ſhould always be equal to the Semidiameter of the Column at its Baſe; but ſome Maſters make it equal to the Semidiameter at the Aſtragal.

THE broad Lift BC, next above the Freeze, is called the Capital to the Triglyph, from whence arifes the Cornice. In Compofitions of thefe Cornices there is not a little Variety; and, I think, they are the very firft, that I have feen to finifh with Cavetto's. They have both a lofty and noble Air, and therefore are beft for the Outfide of magnificent Buildings.

Plates LIII. LIV. *The* Dorick *Order of* VITRUVIUS, *with Intercolumnations for Portico's to Temples*, &c.

FIG. I is a Profile of this antient Mafter, whofe Members are determined by equal Parts, as Infpection makes plain. Fig. II. is the Bafe of the Column more at large. Fig. III. is a Plan of the Plancere of the Corona. Fig VI. exhibits the Manner of placing the Triglyphs, fo as to preferve perfect fquare Metops between them; that is, the Triglyph C being placed directly over the central Line of the Column, the Interval E, which is called Metop, muft, by the Diftance of the next Triglyph B, be made a perfect Square. Therefore, if Triglyphs are not placed exactly over a Column, as A, or if the Metop be a Parallellogram, inftead of a geometrical Square, both are abfurd. An Example of the laft may be feen in that monftrous Frontifpiece to the *South-Sea* Houfe in *Threadneedle-ftreet.*

The Word *Metop* is from the *Greek Meta*, and *Ope*, between three, and was antiently enriched with Oxes Skulls, Difhes, Targets, Battle-axes, Thunderbolts, *&c.* nay, even to this Day thefe Ornaments are ufed, but, for the Generality, with great Impropriety, as being inconfiftent with the Buildings and Situations, of which I have already taken Notice.

FIG. VIII. is a Plan of a Triglyph, exhibiting BA, the Depth of the Chanellings, and G F F, the Intervals between. Fig. V. reprefents *Vitruvius's* Manner of fluting his *Dorick* Column; where, you fee, that his Flutes are defcribed on the Center of a Square, whofe Side is equal to the Breadth of a Flute, as before taught. The Ancients did fometimes cut their Columns into Cants inftead of Flutings, as reprefented by *f*, *g*, *h*, *i*, *k*. Figures IV. VII. and X. are Portico's after the antient *Dorick* Manner, where, you fee, there are not any Bafes to the Columns, as there are to the Portico, Fig. X. The Intercolumnation of this Temple is called *Aræoftyle*, from the *Greek Aræos*, Fair, and *Stylos*, a Column, confifting of 4 Diameters, or Modules: But indeed it is more properly a *Tufcan*, than a *Dorick* Intercolumnation.

By *Intercolumnation*, I mean the Diftance between two Columns, accounted from their Uprights: But fome Mafters account it from the central Line of the one to the fame of the other. The Word comes from the *Latin*, *Intercolumnium*. In the *Dorick* Order, it is regulated according to the Number of Triglyphs included between, excepting where the Triglyphs are excluded, as fometimes they are. The moft natural Intercolumnation for the *Dorick* Order is that called *Diaftylos*, from the *Greek Dia*, between, and *Stylos*, a Column, confifting of three Diameters. Befides thefe, there are two other Kinds of Intercolumnations; as 1*ft*, *Euftylos*, from the *Greek Eus*, Well, and *Stylos*, a Column, (confifting of two Diameters, or very little more, being of all other the moft graceful) for the *Ionick* and *Corinthian*. 2*dly*, The other is *Syftylos*, named alfo *Pycnoftylos*, (as much as to fay, *thick of Pillars*) an Intercolumnation not exceeding 1 diam. and a half, belonging chiefly to *Compofite*.

Plates LV. LVI. *Other* Dorick *Intercolumnations, for Temples and Colonades, by* VITRUVIUS.

FIG. I. reprefents the antient Manner of making Doors to Temples, whofe Breadth at top was made $\frac{1}{14}$ Part lefs than the Breadth at bottom. How convenient fuch Doors may be, as that they will always fhut themfelves at every Opening,

Opening, I cannot ſay; but ſure I am, that as their Sides incline from a Perpendicular, the Intervals, or Margins, between them and the Columns, have not the moſt agreeable Look, by being broader above than below. As to the Proportions of the Door, and its Architrave, *&c.* they are demonſtrable by the Diviſions of Parts. Of this kind of Doors there are ſome made by the Earl of *Burlington*, I think, to the Offices of his Houſes at *Chiſwick* and at *Piccadilly*.

Fig. II. is a *Dorick* Colonade placed on a continued Pedeſtal, which is much more noble and grand, than were each Column placed on a ſingle Pedeſtal, either projecting from the continued Part between, or entirely clear all round.

Fig. III. and IV. are other *Dorick* Intercolumnations for Portico's after the antient Manner, from which, and the preceding, any Deſign of thoſe Kinds may be made with great Facility and Delight.

Plates LVII. LVIII. *Divers* Dorick *Examples from the Ancients.*

THE Example HIK, Plate LVII. and Fig. I. Plate LVIII. are both the ſame Entablature and Capital, being Profiles of that beautiful *Dorick* Order, at the Bath of *Diocleſian* at *Rome*. That of Plate LVIII. has no Baſe; but as Baſes are comely and graceful, therefore I have placed a Baſe to the Profile in Plate LVII. which is ſimilar in its *Cima recta*, in Place of the Torus, to the *Cima recta*, in Place of the Ovolo, in the Capital. The Example CDE, Plate LVII. is very near the ſame Meaſures with (Fig. II.) Plate LVIII. at *Albane*, near *Rome*. Both theſe Examples are very noble, being employed with the *Attick* Baſe E. Fig. B repreſents the Sofito of the Corona of the Entablature C, wherein you ſee that each Mutule or Modillion is enriched with 36 Gutta's or Bells, and the Manner of returning it at an Angle. The Entablature A is another *Dorick* Compoſition of the Ancients, which, having *Gutta's* intermixed with the Dentiles under the Ovolo in the Bed-moulding, is exceeding beautiful for inſide Works, as indeed is that at the Bath of *Diocleſian*, whilſt the other at *Albane*, which is of fewer Parts, is more proper to adorn the Outſide of a Palace. Fig. G is the Baſe and Cornice of a Pedeſtal, to be uſed when the Length of Columns are not ſufficient for the Height required. The Heights and Projectures of every Member from the central Line are determined by Minutes, as expreſſed by the Arithmetical Figures.

Plates LIX. LX. *The* Dorick Order, *by* A. PALLADIO.

FIG. I. and III. repreſent the Pedeſtal, Baſe and Capital of the Column and Entablature at large, whoſe ſeveral Members are determined by Minutes. As I have already ſhewn the Abſurdity of the Annulets under the Ovolo in the Capital, I ſhall in the next Place obſerve, that the Declivity of the Sofito of the Corona hath a very diſagreeable Aſpect, and no wiſe neceſſary; for the ſemicircular Throat at the Extream is ſufficient to prevent the Drip from going any farther, and therefore the Method is abſurd, as well as deformed; for thoſe who are not perfect Judges of the Pretence for ſo doing, do believe that the Corona has ſunk down in its Front. The Sofito of the Cornice to the *Meauſe* Stables is made in this Manner, and is, I think, the very worſt of the Kind, I ever ſaw; and that not only for its drooping Sofito, but for its diminutive Size, being much too ſmall for the Building againſt which 'tis placed. Fig. II. is his Intercolumnation for an *Arcade*, with Pedeſtals to a *Piazza*, or *Gallery*, at whoſe Bottom are two Varieties of Impoſts at large. Fig. IV. are Intercolumnations for a Colonade, whoſe Columns he has placed without Baſes, according to the Ancients. The Figure A on the Right Hand exhibits the Manner of deſcribing the Hollows of his Flutings; and that of BC, Fig IV. the Manner of deſcribing the Ovolo and Cavetto to the Cornice of the Pedeſtal.

The

		Diam.	Min.
The Height of	Pedeſtal and Column	11	0
	Column and Entablature	10	33
	Pedeſtal, Column and Entablature	12	53

Plates LXI. LXII. *The* Dorick Order, *by* VINCENT SCAMOZZI.

FIG I. and II. Plates LXI. LXII. repreſent the Pedeſtal, Baſe and Capital of the Column and Entablature at large, whoſe Members, in their Heights and Projectures, are determined by Minutes. The Flutings of the Shaft are the firſt Thing worth Notice, which are fluted with Fillets, as in the *Ionick*. The Baſe to the Column is of the *Attick* Compoſition, and would be better were it plain, inſtead of being carved. The *Cima reverſa* T, in the Capital, I think, has a more grand Aſpect, than the Annulets in the preceding Profiles. The Gutta's under the Triglyphs are the Sections of the Fruſtums of Cones, and if we are to conſider them as Drops, trickling from the Channels of the Triglyphs, they are more natural, being round, than when made with Angles, as in the Fruſtums of Pyramides. The *Dentiles* in the Cornice do rather belong to the *Ionick*, than to this Order; but I ſuppoſe that this Maſter juſtifies himſelf for ſuch Liberty, as that the Ancients did the ſame in that noble Entablature of *Marcellus*, Plate LII. Fig. III. and Fig. V. are two good Deſigns for Frontiſpieces to Doors. The Entablature within the lowermoſt Frontiſpiece is its own Entablature at large. Fig. IV. Plate LXI. is a Repreſention of the entire Order, wherein

			Diam.	Min.
The Height of the	Pedeſtal and Column	is	9	46
	Column and Entablature		9	37
	Pedeſtal, Column and Entablature		11	53

Plate LXIII. Dorick *Intercolumnations, for Arcades and Portico's, by* VINCENT SCAMOZZI.

THE upper two repreſent the Intercolumnations for *Arcades*, the one with Pedeſtals, the other without. The two lower repreſent the Intercolumnations for *Portico's*, the one with Pedeſtals, the other without. The two Impoſts at the Bottom are what he calls the *Major* and the *Minor*, *viz.* the great, for the Arcades without Pedeſtals, and the leſs, for thoſe with Pedeſtals. The Meaſures of each Figure are Modules and Minutes, by which every Part is determined.

Plates LXIV. LXV. *The* Dorick Order, *by* BAROZZIO *of* Vignola.

THIS Maſter has given us here two Entablatures, that of Fig. I. is of the Theatre of *Marcellus*, of which I have already given the ſame Example, and which is repeated here again only to give it you with the Meaſures of this great Maſter, who makes the Semidiater of the Column his Module, which he divides into 12 Parts, each of which is equal to 2 min. and half. The Entablature, Fig. II. is of this Maſter's Compoſition, compoſed from the Fragments of antient *Rome*, and which, of all the *Dorick* Entablatures I have ever ſeen, is much the moſt noble. The Projection of the Cornice is very grand, as the Sofito is very magnificent in its Enrichments of 36 Gutta's under each Modillion, and Thunder-bolts, *&c.* over the Metops. Indeed, if the Architrave, which is broken into two Faſcia's, had conſiſted but of one, as that of *Marcellus*, I believe 'twould have been no ſmall Addition to the Grandeur of the Entablature. The Capital is of inimitable Compoſition, and admits of Enrichments to a very great Extravagancy. Here he has wiſely excluded

cluded the Annulets and introduced an Aſtragal which looks noble, repreſents Strength, and bears a good Proportion to the other Members, which the Annulets do not. Fig. III. is the Baſe of the Column on its Pedeſtal; which Baſe conſiſts of a Plinth, a *Torus*, and an Aſtragal, which laſt Member is all the Difference, that it hath from the common *Tuſcan* Baſe; nay, it is the very Baſe to the *Tuſcan* Columns in the Portico of St. *Paul, Covent-garden*. The Manner of fluting the Shaft is the ſame as that of *Palladio's*, without Fillets, and their Depths I find are arbitrary, as being deſcribed, either on the Center of a Square, as B, or on the Angle of an equilateral Triangle, as A. The Pedeſtal, I muſt own, I think to be of too great a Height, as being always equal to one third Part of the Height of the Column, *viz.* 5 mod. 4 par. which is equal to 2 diam. 40 min. Nor can I think the Height of his Members in the Pedeſtals, Cornice and Baſe, to be of ſufficient Height and Strength, proportionable to the Greatneſs and noble Aſpect of thoſe Members in the Entablature they belong to.

		Diam.	Min.
The Height of the	Pedeſtal and Column	9	40
	Column and Entablature	10	00
	Pedeſtal, Column and Entablature	12	40

Plate LXVI. Dorick *Intercolumnations, by* BAROZZIO.

THIS Plate repreſents the *Dorick* Intercolumnation for Colonades by *Michael James Barozzio* of *Vignola*, whoſe Meaſures are determined by Modules and Parts, as in the preceding. *Note*, This Plate, by Miſtake of the Engraver, is numbered LXVII.

Plate LXVII. *A* Dorick *Arcade without Pedeſtals, by* BAROZZIO.

THIS Plate exhibits the Intercolumnation for a *Dorick* Arcade, where no Pedeſtals are required, and which would have had a much more noble Effect, had this Maſter made the Pilaſters under the Impoſts equal to the Semidiameter of the Column, inſtead of one quarter or half a Module, which has a thin and mean Aſpect, no wiſe harmonious with the Diameter of the Columns. The Parts are determined by Modules and Parts, as in the foregoing.

Plate LXVIII. *A* Dorick *Arcade with Pedeſtals, by* BAROZZIO: *Alſo,* Dorick *Intercolumnations, for Colonades and Arcades, without Pedeſtals, by* SEBASTIAN LE CLERC.

HERE this great Maſter has fell into an Extream again, by making the Pilaſters as much too broad, as the foregoing are too narrow; theſe being 1 mod. and half, equal to 45 min. are, in my humble Opinion, 15 min. too much; and which any indifferent Eye may diſcover, if the Diameter, and Height of the Column be compared with the Diameter and Height of the Pilaſters, which laſt have a greater Diameter for their Altitude, than the former. The Error of the preceding, in Plate LXVII. is judiciouſly corrected by *Sebaſtian le Clerc*, in his *Dorick* Arcade at the Bottom of this Plate, where his Pilaſters have their Diameters equal to half the Diameter of the Column; and the exceſſive Error in the Pilaſters of this Plate is, in like Manner, corrected by the ſame Maſter in Fig. III. Plate LXXXIII. where they are alſo equal to the Semidiameter of the Column, as before. The Intercolumnations for Colonades by *Le Clerc*, on the left Hand of the Bottom of this Plate, are regulated by the Number of Triglyphs between each Column, as indeed are the Intercolumnations in the aforeſaid Arcades, which Inſpection doth fully demonſtrate.

Plate LXIX. *Two* Dorick *rusticated Gates, by* BAROZZIO.

THESE two Designs, at first View, please a common Eye very well, but, when they are critically examined, they will be found to consist of as many Absurdities, as Beauties. In the first Place, I will not contend, about the Propriety of rusticating this Order, since that this great Master has done it: But however, I do again affirm, that the Multitude of small Members in the Pedestal and Base of Columns and Imposts of Fig. II. have no Affinity with the Rusticks, and that the Breaking of the Entablatures, in both Examples, is monstrously absurd; for tho' the Key-stones to both Arches have a grand Look, by being made large, yet that Grandeur is infinitely less, than the Continuation of the Entablatures: Besides, as I have already observed, the Breaking of the principal Parts makes the Whole appear defective and Weak. Figures A and B are the Profiles of these Examples.

Plate LXX. *The* Frontispiece *to the principal Entrance into the* Farnesean Palace *at* Rome.

THIS Frontispiece is one of the most simply grand Compositions of the *Dorick* Order, that is to be seen in the World. Here, in its native Lines, free from all Manner of Embellishments and Ornaments, you behold all the solemn Greatness and Magnificency that can be desired, and therefore I must recommend it, as an Example worthy of Imitation.

Plate LXXI. *A Triumphal Arch, by* M. J. BAROZZIO.

THIS is a magnificent Design for the Entrance to a Nobleman's Palace, provided that the Entablature be not broken, as is done here, which is absurd. The Pilasters under the Imposts are here too broad, as before in Pl. LXVIII. which must be observed to be made of less Diameter, (as before noted) when a Design of this Nature may be required. As to the other Parts, they are in general of good Composition, the oblong Windows, between the outer Columns on each Side, over the continued Impost, excepted, which ought not to be there. The great Pannel in the Parapet over the Arch may be used as a Table to contain an Inscription when required.

Plate LXXII. *The* Dorick *Gate of* Cardinal FARNESE, *at* Caprarola.

HERE we have another rusticated Example of the *Dorick* Order, but with this Difference, that as the preceding Examples consisted of champhered or *mitred Rusticks*, these are square or *rabbit Rusticks*; and as these Rusticks project beyond the Upright of the Columns, they do therefore, by such Embracing, strengthen them very greatly, according to their Design. The Entablature of this Frontispiece being entire is noble and grand, as indeed are all the Parts of the Whole, and therefore I recommend this Design, as another Example worthy of Imitation and Regard.

Plate LXXIII. *The* Dorick *Order, by* SEBASTIAN SERLIO.

THIS Master presents here an Entablature, crowned with a prodigious Cymatium, placed on a small *Cima recta*, or Cavetto, which bear no Proportion to each other; nor indeed doth the Regula, or Fillet on the Cymatium, which is too low and thin for so great a Member as that to which it belongs. The *Cima recta* under the *Corona* is rather too low and small for the *Corona* and *Cymatium*; but the Height of the Freeze and Architrave, with the Triglyphs

glyphs and Gutta's, are very good. The Capital could not be condemned were the Annulets excluded, it being of a tolerable Compofition. The Bafe of the Column is nearly *Attick*, wherein he has placed a Fillet between the Plinth and lower Torus; and which is intirely right, when the Bafe is elevated confiderably above the Eye; for thereby the Torus is feen more diftinctly, than it could be, were it to fit immediately on the Plinth, whofe Projection would eclipfe a great Part of its Height, and thereby caufe it to have an ill Effect. This being confidered, 'tis evident, that, when the Bafe is placed beneath the Eye, this Fillet muft be excluded, and its Height given to the Plinth and Torus, *viz.* 1 min. to the Plinth, and the half min. to the Torus. The Pedeftal is of a Compofition very particular, having a *Cima reverfa* for its Cornice, fitting on an Aftragal, and crowned with a large *Fillet* or *Regula*. The Bafe of the Pedeftal feems to have been taken from the Bafe of the *Dorick* Column by *Barozzio*, being an Aftragal placed on a Torus and Plinth, as that Bafe is. Thefe Mouldings are divided as follows, (1) The Height of the Pedeftal is equal to 3 diam. of the Column, which being divided into 7 equal Parts, give 1 to the Height of the Cornice, and 1 to the Height of the Bafe. (2) Divide *a e*, the Height of the Cornice, into 4, at *a, b, c, d, e,* and fubdivide *d e* into 3, then the lower 1 is the Fillet, the next 2 the Aftragal; and then giving *a b* to the Regula, the Remainder *b d* will be the Height of the *Cima reverfa*. (3) Bifect *i m*, the Height of the Bafe, in *l*, then *l m* is the Height of the Plinth; bifect *i l* in *k*, then *k l* is the Height of the Torus: Divide *i k* into 3 Parts, then the upper 1 is the Fillet or Cincture, and the lower 2 the Aftragal. The Projection of the Die is always equal to the Projection of the Plinth to the Bafe of the Column. Divide 2 *h*, which is equal to the Projection of the *Die*, into 6 Parts, and make *h w*, and 3 2, each equal to 1 of thefe Parts, for the Projection of the Bafe to the Pedeftal. The Projection of the Cornice to the Pedeftal is a little more than that of the Bafe, that thereby the Bafe may be cleared from the Perpendicular Drip of its Cornice. The Height of the Column is but 7 diam. and the Height of the Entablature 1 diam. 52 min. which is 7 min. more than one fourth Part of the Column's Height. If *Serlio* had made his Column 7 diam. and a half in Height, then the Height of his Entablature would have been within 2 min. of one quarter Part of the Column's Height. Fig. II. reprefents the intire Order, and Fig. III. the fluting of the Column.

			Diam.	Min.
The Height of the	Pedeftal and Column	is	10	00
	Column and Entablature		8	52
	Pedeftal, Column and Entablature		11	52

Note, The Meafures of the Bafe and Capital of the Column, and of the Entablature, are determined by Modules and Minutes, of which the Projections are accounted from the central Line.

Plates LXXIV. LXXV. Dorick *Intercolumnations for Portico's with Frontifpieces, by* S. SERLIO.

FIG. I. and Fig. II. reprefent Intercolumnations for Portico's to Temples, *&c.* which are both of the fame Kind, as appears by the Triglyphs over each Interval. That of Fig. I. confifts of fix Columns, and that of Fig. II. of four only, each having three Triglyphs in the middle Interval, and two only in every of the other, exclufive of thofe over each Column. Fig. III. is another rufticated *Dorick* Example, which, in a Grotefque Building, would have a fine Effect, was but the Entablature whole, inftead of being broken in fo barbarous a Manner by the rufticated projecting Key-ftones, which do not only fill up the Place of the Architrave, Freeze, and Bed-moulding, but the Tympanum of the Pedeftal alfo. The lower Rufticks of the Columns being placed in the Stead of their Bafes, have a good Effect, and do better become

thofe

thoſe Places, than the common Baſe to the Column would have done. Figures IV. and V. are two Examples of Doors from the Ancients not unworthy of our Notice.

Plate LXXVI. Dorick *Intercolumnations for Colonades and Arcades, by* S. SERLIO.

FIGURE I. repreſents the Intercolumnations proper for a *Dorick* Colonade, wherein the Columns are placed nearly in Pairs, and which in ſome Places have a very noble Effect. Fig. II. is an Arcade to a Piazza, whoſe Arches ſpring from Pilaſters, or rather from ſquare Columns, placed to ſupport the Impoſts, which here is turned into Capitals that ſeem to be ſimilar to the Capitals of the Columns, that ſuſtain the Entablature over them. I muſt own, that this is the firſt Example of the Kind I have yet ſeen, and which is very well worth our Notice, as that in many Caſes it may better ſuit our Purpoſes, than any other we may think on. Fig. III. is another Kind of Arcade in the *Venetian* Manner, which is alſo of good Invention, and of greater Strength, than the preceding.

Plate LXXVII. *A* Dorick *Temple,* by BRAMANTE.

THIS Temple is a Deſign of that famous Architect *Bramante,* who deſigned St. *Peter's* at *Rome,* and is of a noble Taſte. By the dotted Circles you ſee, that the whole Height is divided into two Parts, the lower one extending from the Baſe of the Columns, to the Top of the Baluſtrade, and the other from thence, to the Vertex of the Dome. The Corridore of Columns which environ the Building, and which ſupport the Gallery above, have a noble Aſpect, as well as afford good Shelter from the Weather below, and a pleaſant View from the Gallery above, when a Building of this Kind is erected on a pleaſant Situation in a Garden, Park, *&c.*

Plates LXXVIII. LXXIX. *Deſigns, by* S. SERLIO.

FIG. I. is a Deſign for a Gate or Door, where the Corona is ſupported by Truſſes placed in the Freeze; which Truſſes have their Face's channeled in Manner of the Triglyphs, and their Gutta's under them in the Architrave. I muſt own, I think the whole has a good Aſpect; but whether the Converſion of the Triglyphs into Truſſes (called, by ſome Maſters, *Mutules*) be warrantable I will not undertake to determine. Fig. II. is the Deſign of an *Altarpiece* of good Invention. Fig. III. is the Deſign of a Triumphal Arch of good Invention alſo; wherein you ſee, that between the two middle Columns, there are five Triglyphs, and between the outer Columns but two. Fig. IV. is a *Dorick* Arcade in a very grand Taſte, and where there are but four Triglyphs, between thoſe over the Columns, inſtead of five, as in the preceding.

Plate LXXX. *The* Dorick Order, *by* S. LE CLERC.

IN this Plate we have two Varieties of Entablatures, *viz.* A and B, which are both finiſhed with Cavetto's, in Manner of ſome of the foregoing Maſters, as indeed are three other Entablatures in Plate LXXXI. The Meaſure, by which this Maſter determines his Members, is the Semidiam. of the Column divided into 30 min. as before taught. As to the Difference of each Entablature, from each other, that is better ſeen by comparing them together, than deſcribing them by Words, to which I refer you. The Height of the Column is 16 mod. or Semidiameters of the Column; the Entablature 3 mod. 28 min. and the Pedeſtal 5 mod. 10 min.

The

		Diam.	Min.
The Height of the	Pedeſtal and Column	10	40
	Column and Entablature	9	58
	Pedeſtal, Column and Entablature	12	38

Plate LXXXI. Dorick *Entablatures and Sofito's, by* S. LE CLERC.

THE three Entablatures exhibited on this Plate (as I before obſerved) being compared together, conſiſt of the ſame Members, and differ only in their Heights and Projectures, as expreſſed by the Meaſures affixed. Fig. III. V. VI. and VII. repreſent various Ways of turning the Sofito of the Corona at an Angle, and of dividing and placing the Mutules over each Triglyph in the Freeze, which a little Inſpection will make more plain, than Words can do.

Plate LXXXII. *Other Examples of the Diviſions of* Dorick *Sofito's for Practice, by* S. LE CLERC.

Plate LXXXIII. Dorick *Intercolumnations for Arcades,* &c. *with their Impoſts, by* S. LE CLERC.

FIG. I. repreſents a *Dorick* Arcade without Pedeſtals, to be made either with ſingle Columns, as on the Right, or with Columns in Pairs, as on the Left. Fig. II. and III. are Arcades with Pedeſtals, to be uſed as Occaſions require. Figures A, B, C, D, are four Varieties of Impoſts, of which Choice may be made at pleaſure. Fig. IV. is an Intercolumnation proper for a Colonade, to be uſed either with a continued Pedeſtal, as here repreſented, or without, as the Nature of the Building may demand.

Plate LXXXIV. Dorick *Examples for Practice, by* S. LE CLERC.

THIS great Maſter having given us his various Entablatures, Sofito's, Arcades, *&c.* he now finiſhes this Order with an Example of placing the *Dorick* Order on the *Tuſcan,* as exhibited on the right Hand of this Plate, wherein 'tis to be noted, (1) That the Diameter of the *Dorick* Order at its Baſe is equal to the Diameter of the *Tuſcan* at its Aſtragal. (2) That the central Lines of the lower Order and of the upper Order be the ſame, or one continued Line, ſo that the upper Column may ſtand exactly over the under. (3) That the Pilaſters of the upper Arcade ſtand exactly over thoſe of the lower, whereby the Solid will ſtand over the Solid, which is a general Rule to be obſerved in all Parts of Buildings in general. The other two Examples for Gates, and the Rotunda, or round Temple, are added for the Exerciſe of the young Practitioner.

Plate LXXXV. *The* Dorick Order, *by* CLAUDE PERAULT.

IF this Maſter had omitted the Annulets in the Capital, and introduced an Aſtragal in its ſtead, the Whole would have been a fine Compoſition.

To proportion this Order to any given Height.

DIVIDE the given Height into 37 equal Parts, give 7 to the Height of the Pedeſtal, 24 to the Height of the Column, and 6 to the Height of the Entablature. The Diameter of the Column is equal to 3 of the aforeſaid Parts. *To divide the Pedeſtal into its Cornice, Die and Baſe,* divide the given Height into 8 Parts, give 1 to the Cornice, 5 to the Die, and 2 to the Baſe. *To divide the Mouldings of the Cornice of the Pedeſtal,* divide the Height *by* into 9 equal Parts, give 1 to the Regula, 5 to the Faſcia, 1 to the under Fillet,

and 2 to the Cavetto. *To divide the Mouldings of the Base of the Pedestal,* divide the Height *g k* into 3 equal Parts; give 2 to the Plinth *h k*, and the upper 1 being divided into 2, give the lower 1 to the Torus; and then, this last upper 1 being divided into 3, give the lower 1 to the Fillet, and the upper 2 to the Cavetto. *To divide the Mouldings of the Base to the Column*; (1) the entire Height being equal to half the Diameter, divide it into 3 equal Parts, and give the lower 1 to the Plinth. (2) Divide the remaining 2 into 4 Parts, and give the upper 1 to the upper Torus. (3) Divide the Remainder into 2, and give the lower 1 to the lower Torus. (4) Divide the last 1 remaining into 6, give the upper 1 to the Fillet under the upper Torus, the lower 1 to the Fillet on the lower Torus, and the remaining 4 to the *Scotia. This is the true* Attick *Base. To divide the Capital into its Parts,* divide the given Height into 3 equal Parts, give 1 to the Abacus, 1 to the Ovolo and its Annulets, and the lower 1 to the Neck. The Astragal, with its Fillet, is equal to half the Height of the Neck, and the Fillet is a third of that Height. The Height of the Ovolo and its Annulets being divided into 3, give the lower 1 to the Annulets, which subdivide into 3 also. The Height of the Abacus being divided into 3, give the upper 1 to its Cima and Fillet; and that being subdivided again into 3, give the upper 1 to the Fillet, and the lower 2 to the *Cima reversa. To divide the Entablature into its Architrave, Freeze, and Cornice,* divide the Height into 24 equal Parts, give 6 to the Architrave, 10 to the Freeze, including the Capital of the Triglyph, and the upper 8 to the Cornice. *To divide the Architrave,* divide the Height into 7 equal Parts, and give the upper 1 to the *Tenia,* and the next 1 and a third to the Depth of the *Gutta's. To divide the Cornice*; its Height being divided into 8 equal Parts, as aforesaid, give the upper 2, and a fourth of the next 1, to the Height of the *Cymatium,* and the remaining three fourths of the third Part, to the Height of the *Cima reversa.* The next 1 and half is the Height of the *Corona,* the next half to the *Cima reversa* on the Mutule, and the next 1 and half is the Height of the Mutule itself; the remaining 1 and half is the Height of the Cavetto, which finishes the Whole.

To determine the Projectures.

(1) DIVIDE the Diameter of the Column into 14 equal Parts, and make the Projection of the Plinth, to the Column's Base, equal to 3 of those Parts. The middle 1 of the 3 Parts in the Plinth being divided into 3, and Lines drawn from thence perpendicular to the Base (as the dotted Lines running up to the Capital) terminate the Projections of the upper Torus and Fillets to the Scotia. *The Projection of the Plinth* limits the Projection of the Die. On *e*, with the Radius *e f*, describe the Semicircle *f d z*; then is *e d* the Projection of the Plinth to the Pedestal. The Projection of the Abacus of the Capital is equal to that of the upper Torus; that of the Ovolo to that of the Cincture, and that of the Astragal to the Upright of the Column. The Diminution of the Shaft at the Astragal is one seventh Part of the Diameter at its Base. *To find the Projection of the Cornice,* (1) Divide the Height of the Cornice, including the Capital of the Triglyph, into 12 equal Parts. (2) Continue the upright Line of the Architrave and Freeze through the Cornice, until it cut the upper Line of the *Regula* on the Top of the upper Cima of the Cornice. This done, on the upper Line of the Fillet, set along 16 equal Divisions, each equal to 1 of the 12 found in the Height of the Cornice; then will the 16th be the Projecture of the *Cymatium,* the 14th of the *Cima reversa,* the 13th of the *Corona,* the 12th of the Mutule or Modillion, the 5th of the lower Cima reversa, the 4th of the Cavetto, and the 2d of the Triglyph in the Freeze; and thus is the Whole completed, as required. Figure K represents the Sofito of the Corona, and Figure M the geometrical Rule for describing the Cima recta and reversa.

THAT of the Cima recta is no more than 2 equilateral Triangles, whose Sides are

are each equal to half *a b*; that of the Cima reverſa hath its Projection divided into 6 Parts, of which 1 is given to the Projection of its Foot, and the other 1 to the Projection of its Fillet, then the Curve is deſcribed by two equilateral Triangles, as before.

Plate LXXXVI.

THIS Plate was number'd Plate LXXXVII. by Miſtake of the Engraver, and printed off before diſcovered, therefore the *Dorick* Orders of *Viola*, *Alberti*, *de Lorme*, and *Bullant*, which were to have been Plate LXXXVI. are now become

Plate LXXXVII. *The* Dorick *Orders of* LEONI BAPTISTA VIOLA LEONI BAPTISTI ALBERTI, PHILIP DE LORME, *and* JOHN BULLANT.

THESE Profiles are from Mr. *Evelyn*, and have their Members determined by Minutes, of which the Projections are from the Central Line. As Inſpection demonſtrates the Difference of each Maſter, I need not enlarge thereon; and therefore I ſhall only obſerve, that the Capital of *Alberti* is monſtrouſly high, being 43 min. which is 13 min. more than by any other Maſter, and of a poor Projection. The Ovolo in his Bed-moulding, being without the Cavetto under it, looks very heavy and dull, and unworthy of Imitation. In ſhort, the whole Entablature is a bad Compoſition, whilſt every of the other three are worth our Conſideration.

Plate LXXXVIII. *The* Dorick *Order, by the Reverend* DANIEL BARBARO, *and* CATANEO.

THESE Maſters are alſo from Mr. *Evelyn*, and have their Parts determined by Minutes, as the preceding; and their Variations in each Member are alſo demonſtrable by Inſpection, as the former. The *Dorick* Temple A is an Example for Practice, by way of Digreſſion from the Courſe of the Order.

Plate K to follow Plate LXXXVIII. *The* Dorick *Pedeſtal, by* JULIAN MAU-CLERC.

To find the Height of the Pedeſtal to an entire Order, as Fig. A, Plate LXXXIX. divide the given Height into 8 equal Parts, and give the lower 2 to the Height of the Pedeſtal. *The Height of the Pedeſtal being given,* divide it (as in Plate K) into 7 equal Parts; give 1 to the Height of the Baſe, and 1 to the Height of the Cornice. *To divide the Mouldings of its Baſe,* divide its Height into 2 Parts, and give the lower 1 to the Height of the Plinth; alſo divide the upper 1 into 2, and give the lower 1 to the Height of the Torus; alſo divide this laſt upper 1 into 3, give the upper 1 to the Fillet, and the lower 2 to the Aſtragal; and thus is the Baſe completed, as exhibited on the Right-hand Side. On the Left-hand Side, the Baſe is divided in a different Manner, as follows, *viz.* The Plinth is equal to half its Height, the Torus to two Thirds of the Remainder, and the Fillet to a Sixth of the Whole. *The Mouldings of the Cornice* are alſo divided in 2 different Ways; as *firſt*, that on the Right, the Height being divided into 4 Parts, give the upper 1 to the *Regula*, the lower 1 to the *Aſtragal*, and the middle 2 to the *Cima reverſa*; the Height of the Aſtragal being divided into 3, give 2 to the Aſtragal, and 1 to the Fillet. *Secondly*, that on the Left; divide the Height into 5 Parts, give the lower 1 to the Aſtragal, ſubdivided into 3, as before; the next 2 to the

the *Cima reverſa*, the next 1 and half to the Faſcia, and the half of the upper 1 ſubdivided into 3 to the *Regula* and its *Cima*. If the Diameter of the Die of the Pedeſtal be given to find its Altitude, complete a geometrical Square whoſe Side is equal to the Diameter of the Die, and make the Altitude of the Die equal to the Diagonal of the Square, as is very plainly demonſtrated in the Figure. This done, divide the Altitude of the Die into 5 Parts, and then giving 1 to the Cornice, and 1 to the Baſe, proceed to divide their Parts as before.

Plate LXXXIX. *The* Dorick Order *entire, by* JULIAN MAU-CLERC.

THE Manner of finding the Height of the Pedeſtal being explain'd in the laſt Plate, we will now proceed to find the Height and Diameter of the Column, as alſo the Height of the Entablature. Divide the Height of the Pedeſtal, Column and Entablature into 12 equal Parts, and give the upper 2 to the Entablature; the Diameter of the Column is equal to 1 of thoſe 12 Parts; the Column is diminiſhed ⅙ of its Diameter, and the Height of the Capital is equal to a Semidiameter of the Column.

Plate XC. *The* Tuſcan Order *at large, by* J. MAU-CLERC.

THIS Plate exhibits by Inſpection the Diviſions of the Members in the principal Parts of this Order, of which I have already ſpoken, in the Explanation of the *Tuſcan* Order by this Maſter; and as the Diviſions of the Members are very plain and eaſy, they need no further Explanation.

Plate XCI. *The* Dorick Order *at large, by* J. MAU-CLERC.

THE Manner of dividing the Pedeſtal into its Parts being demonſtrated by Plate K, and the Manner of finding the Height of the Pedeſtal, Column and Entablature being exhibited by Fig. A, Plate LXXXIX. I ſhall now explain the Manner of Dividing the Baſe and Capital of the Column and the Entablature into their reſpective Members.

I. *To divide the Members in the Baſe to the Column.*

THE Height being equal to the Semidiameter of the Column, divide it into 3, the lower 1 is the Plinth; the remaining Height divided into 4, the upper 1 is the upper Torus; the Remains divided into 2, the lower 1 is the lower Torus; the upper 1 divided into 7, the upper and lower ones are the Fillets and the Remains between the Scotia. This is the *Attick* Baſe, as before delivered in *Perault* on the *Dorick* Order. The Projection of the Plinth is equal to one fourth Part of the Diameter of the Column. This is alſo exhibited in Plate E to follow Plate XCI.

II. *To divide the Members in the Capital.*

THE Height being equal to half the Diameter, divide it into 3 Parts, give 1 to the Neck, 1 to the Ovolo with its Annulets, and 1 to the Abacus; then ſubdivide them, as in the Figure for their Parts.

III. *To divide the Entablature into its Architrave, Freeze and Cornice.*

DIVIDE its Height into 7 equal Parts, give 2 to the Architrave, 3 to the Freeze, and 2 to the Cornice; then ſubdivide the Members, as exhibited by the Diviſions againſt them. Here are two Varieties of Cornices, and I think neither of them good; that on the Right being finiſhed with a monſtrous *Cima recta*, on a decripid *Cima reverſa* under it; and that on the Left being much too high for its Freeze, and conſiſts of the two Faſcia's, next over the Capitals of the Triglyph, more than it ought to have, they making a treble Repetition of the ſame Member, which is abſurd.

Plate

Plate E to follow Plate XCI.

THIS Plate exhibits one of the ancient Manners of enriching the *Attick* Bafe, when ufed with the *Dorick* Order, as alfo of the Capital, which are given here as Examples for Imitation, or Help to Invention.

Plate O and Plate P following Plate E after Plate XCI.

THESE Plates reprefent the Entablatures of the preceding *Dorick* Examples more at large than in Plate XCI. wherein the aforefaid Errors are more obvious.

Plate P following Plate O after Plate XCI. *The* Dorick Order, *by* A. PALLADIO, V. SCAMOZZI, *and* M. J. BAROZZIO *of* Vignola, *according to Mr.* EVELYN.

Note, The feveral Members of thefe Profiles are Minutes accounted from the central Line.

Plate XCII. *The* Dorick Order, *by* INIGO JONES.

THIS *Dorick* Order is executed in the Screen to the Royal Chapel in *Somerfet-Houfe*, and is one of the moft beautiful Performances I ever faw. The Heights and Projections of the feveral Members are determined by Inches and Parts. The Diameter at the Bafe is 17 inch. and $\frac{1}{2}$, and 14 inch. at the Aftragal, being diminifhed $\frac{1}{5}$. Here we fee, that this Mafter has at once kick'd away the Triglyphs, and introduced Leaves in their Stead, which a very noble Afpect, as well in Profile as in Front; and that thefe Leaves might not be thought ufelefs, he has brought forward the Sofito of his Bed-moulding, for them to fupport. In brief, the Compofition is grand, and the Enrichments are very noble, and worthy of Imitation.

Plate XCIII. Dorick *Intercolumnations, by* I. JONES.

THIS Plate reprefents the Plan and Elevation of the lower Part of the Screen in the Royal Chappel aforefaid, where the Intercolumnations are (denoted by Feet and Inches, and) very grand.

Plate XCIV. *The* Dorick Order, *by Sir* CHRISTOPHER WREN.

THIS Profile is an exact Reprefentation of the *Dorick* Order in the Frontifpiece of the Steeple of *St. Mary-le-bow*, in *Cheapfide, London*, whofe Entablature is of a very extraordinary Compofition, and has a very good Effect. The Height and Projectures of the Members are denoted by Feet and Inches, as alfo are thofe of the Impoft and Intercolumnation in the Frontifpiece itfelf, exhibited in Plate XCVII.

Plates XCV. XCVI.

THE great *Pillar*, or *Monument* of *London*, begun in the Year 1671, and finifhed in 1677, according to the Defigns, and under the Conduct of Sir *Chriftopher Wren*, Knt. Surveyor General of the Royal Works, and of the Cathedral of *St. Paul*, and all the Parochial Churches and publick Buildings of *London*, after the Conflagration of the City, 1666.

THIS ſuperb Column never having appeared in Print, with its Meaſures affixed thereto, I have therefore, with great Pains and Care, meaſured every Part thereof. As I am ignorant of the Manner how this great Maſter determined the Height and Projecture of its Parts, I have been obliged to form a Method different from what is generally practiſed, in order to come at a right Knowledge of its Dimenſions, which Method is ſo eaſy, that Inſpection only will make it underſtood by the Judicious.

BUT as this is a capital Building in the *Capital City* of *Great Britain*, (and which I believe the whole World cannot equal for Magnitude) I am willing that thoſe, who have as yet but a ſlender Knowledge of *Architecture*, ſhould be thoroughly acquainted with the Conſtruction of its Parts, therefore I ſhall give a full Explanation as follows.

The general Proportions of the whole Monument, as exhibited in Fig. I.

THE Height of the *Column* with its *Capital* and *Baſe*, but without its *Sub-plinth* is 8 times its Diameter at the *Baſe*, which is 15 Feet; the Height of the *Pedeſtal* (without the *Sub-plinth* of the *Column*) is one third Part of the Column's Height; and the Height of the *Cippus* (or circular Pedeſtal) on the top of the *Column*, together with the *Vaſe*, (or Fire-pot) excluding the Flame, is equal to the Height of the *Pedeſtal*.

To determine the Heights of the particular Parts.

THE Semidiameter of the *Column*, Fig. II. is equal to the Height of its *Baſe*, viz. the *Plinth* and *Torus*. Divide the Height of the *Baſe* into 7 equal Parts, which Parts will ſerve as general Meaſures throughout the Whole, give 4 Parts to the *Plinth*, 3 to the *Torus*, and 1 to the *Fillet* of the *Cincture*. The *Pedeſtal* is equal to 36 parts, give 9 to the *Baſe*, 21 and 2 thirds to the *Die*, and 5 and 1 third to the *Capital*. *To divide off the Members of the Baſe of the Pedeſtal*, give 3 parts and half to the *Sub plinth*, 1 and half to the *Plinth*, 1 to the *Torus*, 2 to the *Cima recta* and two *Fillets*; divide 1 part into 4, and make each *Fillet* equal to one of thoſe 4 parts, give one whole part to the upper *Torus* and *Fillet*; the *Fillet* is equal to one fourth, as before. The Frame of the *Pannel* in the *Die* is equal to 2 parts, give 1 to the plain Margin, and the other to the carv'd *Cima recta* and *Fillet*; divide this laſt into 8 parts, and give 1 to the *Fillet*.

To divide the Members of the Capital of the Pedeſtal.

GIVE 1 part to the *Cavetto*, *Fillet*, and *Aſtragal*, viz. one half to the *Aſtragal*, and the other half being divided into 3, give 1 to the *Fillet*, and 2 to the *Cavetto*; give 2 whole Parts to the *Cima recta*, one and half to the *Faſcia* or *Corona*. and the *Fillet* under it, which is one ſixth of a part, half a Part to the *Cima reverſa*, and one third to the *Regula*; give the remaining 2 thirds, and 6 more whole Parts, to the *Sub-plinth* of the *Column*. The Height of the *Capital* is 8 parts, ſo that it is 1 part higher than the *Baſe*, which is very uncommon; doubtleſs the Reaſon is its great Altitude, which in ſom meaſure contracts, or fore-ſhortens the perpendicular Lines, and makes the Whole appear not ſo high, as it really is, therefore this ſhould never be practiſed in other Kinds of Buildings.

To divide the Members of the Capital.

DIVIDE 1 part into 3, and give 1 to the *Regula*, and 2 to the *Cima reverſa*; give 2 whole parts to the *Abacus*, and 2 to the *Ovolo*; divide 1 part into 3, and give 2 thirds to the *Aſtragal*, and 1 third to the *Fillet*; give 2 whole Parts to the Neck of the *Capital*, 1 to the *Aſtragal* of the *Column*, and half one to the *Fillet*.

To

To divide the Base of the Cippus into its Members.

GIVE 2 Parts and half to the *Sub-plinth*, 1 and half to the *Plinth*, 3 fourths to the *Torus*, and the remaining 1 fourth to the *Fillet* of the *Cincture*, which is Part of the *Die*. The Height of the *Die* is 3 times the Height of the *Base*, viz. the *Sub-plinth*, *Plinth*, and *Torus*.

To divide the Capital of the Cippus into its Members.

GIVE 1 fourth of a Part to the *Regula*, half a Part to the *Fascia*, half a Part to the *Ovolo*, and 1 fourth to the *Astragal* and *Fillet*; divide this fourth into 3, and give 2 to the *Astragal*, and 1 to the *Fillet*. The Height of the great *Cima recta*, or the Crown of the *Cippus*, is 4 whole Parts; the *Astragal* and *Fillet* together are 3 fourths; divide the lowest fourth Part into 3, and give 2 to the *Fillet*; the Height of the great *Fillet* above the *Astragal*, or the *Plinth*, to the *Vase* (or Fire-pot) is equal to the Height of the *Astragal*.

To determine the Projectures.

THE Projecture of the *Fillet* of the *Cincture* is equal to its Height, *viz.* 1 Part from the Upright of the *Column*, and that of the *Plinth* is 3 Parts, the Swelling of the *Torus* being perpendicular to the Out-line of the *Plinth*, divide the Height of the *Plinth* into 3 equal Parts, one of which is the Projecture of the *Sub-plinth*; the Projecture of the *Die* of the *Pedestal* is the same with that of the *Sub-plinth* of the *Column*.

To determine the Projectures of the Members of the Capital of the Pedestal.

THE Projection of the *Fillet* over the *Cavetto* is equal to the Height of the *Cavetto* and *Fillet* together; the Bottom of the *Cavetto* projects as much as the Height of the *Fillet* above it; from the Perpendicular of the Projection of the *Fillet*, describe the Out-line of the *Astragal*, which determines its Projection; the Projecture of the *Fillet* over the *Cima recta* is equal to the Height of the *Cima* and the *Astragal* without the *Fillet* under it; and that of the *Fascia* to the Height of all the Members below it; the Projection of the *Regula*, from the Upright of the *Fascia*, is equal to the Height of the *Cima reversa*.

To determine the Projectures of the Members of the Base of the Pedestal.

THE Projecture of the upper *Torus* is equal to its Height, and the Projecture of the 2 upper *Fillets* is half that of the *Torus*; the Projecture of the lower *Fillet* is equal to the Height of the *Cima recta*, and both the *Fillets*; the *Torus* and *Plinth* project one half Part from the lowest *Fillet*, and the *Sub-plinth* twice as much, or one whole Part. The Semidiameter of the *Column* is diminished, from 7 Parts at the *Base*, to 5 and one third at the *Astragal*.

To determine the Projectures of the Members of the Capital.

THE Projecture of the *Astragal* of the *Capital* is equal to its own Height, and that of the *Fillet* under it is equal to its own Height also; the Projecture and Height of the *Ovolo* are likewise equal, and the Projecture of the *Abacus* is equal to the Height of the *Ovolo* and *Astragal* together; the *Regula* projects, before the Upright of the *Abacus*, as much as the Height of the *Cima reversa*. The *Fillet* under the *Astragal* of the *Column* projects equal to that of the *Astragal* of the *Capital*, and the Swelling of the *Astragal* beyond the *Fillet* is half its own Height. The Projection of the *Fillet* and *Astragal* of the Column is very small in Proportion to their Height; the Reason of which I take to be this; had they projected more, at so great a Height, the *Astragal* would have hid a great Part of the Neck of the *Capital*, which would have had an ill Effect.

To

To determine the Projectures of the Members of the Base of the Cippus.

THE Body of the *Cippus* is equal to the *Column* of its *Astragal*; the *Torus* of its *Base* projects as much as its own Height, the *Plinth* equal to the *Torus*, and the Fillet of the *Cincture* half as much; the *Sub-plinth* projects, beyond the *Plinth*, 1 fourth of the Height of the *Plinth*.

To determine the Projectures of the Members of the Capital of the Cippus.

THE *Fillet*, *Astragal* and *Ovolo* do each project equal to its own Height; the Projecture of the *Regula* is the same with that of the *Torus* and *Plinth*; and that of the *Fascia* is half the Distance between the Projecture of the *Ovolo* and that of the *Regula*. The Projecture of the *Fillet* under the upper *Astragal* is 3 Parts from the central Line, the Swelling of the *Astragal* half its Height beyond it; the great *Cima*, and the *Fillet* above, are 1 sixth part backward.

HAVING thus shown how this noble *Column* and its particular Members may be divided by Parts, I shall in the next Place sum up the Number of Parts contained in the whole Height, as thus,

Base of the Pedestal	9
Die of the Pedestal	21 $\frac{8}{12}$ or $\frac{2}{3}$
Capital of the Pedestal	5 $\frac{4}{12}$ or $\frac{1}{3}$
Sub-plinth of the Column	6 $\frac{8}{12}$ or $\frac{2}{3}$
Base of the Column	7
Shaft of the Column	93
Capital of the Column	8
Base of the Cippus	4 $\frac{3}{12}$ or $\frac{1}{4}$
Body of the Cippus	14 $\frac{3}{12}$ or $\frac{1}{4}$
Capital of the Cippus	1 $\frac{6}{12}$ or $\frac{1}{2}$
Great Cima	4
Astragal with the small Fillet and Plinth of the Vase	1 $\frac{4}{12}$ or $\frac{1}{3}$
Vase	12
	188 $\frac{6}{12}$ or $\frac{1}{2}$

Thus it appears there are 188 parts and half in the whole Height, let us now reduce these Parts into Feet, and see what the Height of the Whole is by that Measure. You may remember I divided the Semidiameter of the *Column* into 7 Parts, so the Whole is 14 parts and 15 Feet; but before I state the Question, I must reduce the Parts into Half-parts, because there is an odd Half: So the Question stands thus, If 28 Half-parts give 15 Feet, what do 377 Half-parts give?

```
188 ½
  2
-----           14
376              2
  1             --
-----           28
377
```

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28———15———377        28)5655(201 27/28
           15            56
         ----            ----
          1885           0055
          377              28
         ----            ----
          5655             27
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BY this Operation it appears, that the whole Height is 201 Feet, and 27 twenty-eighths of a Foot, which is so near 202, that we need not scruple to say it is so by this Method of working. This is the Height which one of the Inscriptions upon it assigns it; and it was that Distance Eastward from it, that the Fire of *London* began, which was the Reason of its being that Height.

FIG.

FIG. III. reprefents the Plan of the *Column* at its *Bafe*, which being 15 Feet is divided into 5 equal parts of 3 Feet each, the firft is folid Wall, the fecond is the Length of the Stairs, the third is the *Newell* or Well-hole from top to bottom, the fourth is the fame with the fecond, and the fifth as the firft, the Circle of Stairs is divided into 24, which fhows there are fo many in one Round.

FIG. IV. V. exhibit the *Column* of *London*, and that of *Trajan* at *Rome* by the fame Scale, which fhows the latter is but 3 fourths of the Height of the former.

Plate XCVII. *A* Dorick *Intercolumnation, by Sir* C. WREN.

FOR the Explanation of this Frontifpiece *vid.* the Explanation of Plate XCIV.

Plate XCVIII. XCIX. *The* Dorick Order, *by Mr.* GIBBS.

(1) THE firft Figure on the left Hand reprefents the *Dorick* Order entire, according to this Mafter, whofe entire Height being divided into five Parts, give the lower 1 to the Height of the Pedeftal, and the upper 4 to the Height of the Column and Entablature; which faid Height being divided into 5, give the upper 1 to the Height of the Entablature, and the lower 4 to the Height of the Column. (2) Divide the Height of the Column into 8 Parts, and take 1 for its Diameter. The Height of the Bafe (which is *Attick*) is equal to the Semidiameter of the Column, as alfo is the Height of the Capital; and the Shaft is diminifhed, from one third of its Height unto its Aftragal, one fixth Part of its Diameter; and thus are the general Parts of this Order determined. The next Figure reprefents the Pedeftal and Bafe of the Column at large, whofe Parts are divided as follow, *viz.* (1) *The Height of the Pedeftal being given, to divide it into its Bafe, Die,* and *Cornice,* divide the given Height into 4 Parts; give the lower 1 to the Height of the Plinth, and $\frac{1}{2}$ of the next 1 to the Height of the Mouldings. *The Height of the Cornice* is equal to one eighth Part of the whole Height, or half of the upper 1. (2) *To divide the Mouldings of the Bafe,* divide the Height of the Mouldings into 8, give the upper 2 to the Cavetto, the next 1 to the Fillet, the lower 1 to the lower Fillet, and the remaining 4 to the *Cima recta.* The Projection of the Bafe of the Pedeftal, from the Upright of the *Die,* is equal to its Height. The Upright of the *Die* is equal to the Projection of the Plinth to the Column's Bafe; and the Projection of that Plinth, from the Upright of the Column, is equal to one fixth Part of its Diameter. If the Projection of the Plinth of the Pedeftal, from the Upright of the *Die,* be divided into 8 Parts, (as under its Mouldings) one half of the firft 1 is the Projection of the upper part of the *Cavetto,* the next 2 of the Fillet, and the 7th of the lower Fillet on the Plinth. (3) *To divide the Mouldings of the Cornice,* divide the Height into 4, give the lower 1 to the *Cavetto* with its Fillet, the next 1 to the *Ovolo,* half the upper 1 to the *Regula,* and the Remainder to the Plat-band or *Fafcia.* (4) *To divide the Mouldings of the Bafe to the Column,* divide the Height into 3, give the lower 1 to the Plinth; divide the middle 1 into 4, and give 3 to the lower Torus, and half the upper 1 to the Fillet; divide the upper 1 into 4, give the upper 2 and half to the upper Torus, and the other half to the Fillet, the Remainder is the Height of the *Scotia.* Thefe Mouldings of the Bafe and Cornice of the Pedeftal, and of the Bafe to the Column, are defcribed at large by Fig. V. and VI. in Plates C. and CI. (5) *To divide the Mouldings of the Capital,* Fig. I. Plate C. divide the Height into 3, give the lower 1 to the Neck A, the next 1 to the *Ovolo* with its *Cavetto,* and the upper 1 to the *Abacus*; then fub-divide them as is reprefented by the Sub-divifions. The Projection of the Abacus is equal to one quarter of the Column's Diameter at its Aftragal, which being fub-divided into 4 parts, at 2, 3 and 4, the

Point 2 is equal to the Projection of the Fascia C, and the Point 4 to the Projection of the Fillet under the *Ovolo*; the Projection of the Fascia C, over the *Ovolo* B, is equal to ¼ of the Part 2 3; *lastly*, the outer Division being subdivided into 6, the first and last ones determine the Projection of the *Cima reversa*, which compleats the Capital. (6) *To divide the Entablature into its Architrave, Freeze and Cornice*, divide the given Height into 8 Parts, give 2 to the Architrave, 3 to the Freeze, and as many to the Cornice. The Breadth of the Triglyph is equal to the Semidiameter of the Column at its Base, and the Distance of the Triglyphs, which is the *Metops*, is equal to the Height of the Freeze. I must here take the Liberty to observe, that this and all the preceding Masters on the *Dorick* Order, are entirely wrong in making their *Metops* truly square, instead of making them to appear so, which they can't do, if they are made truly square. This is indeed a Paradox; but the Truth is, if the Architrave be above the Eye, the Projection of the Tenia will eclipse a Part of the Height of the Freeze, and consequently the Metops will appear Parallelograms, of greater Length than Height, and that more and more as you approach the Building: Therefore, to make the Metops appear as Geometrical Squares at any assign'd Distance, there must be an extraordinary Height given to the Freeze, as shall be equal to that Part of the Freeze, that may be eclipsed by the Projection of the *Tenia*. (7) *To divide the Architrave into its Tenia and Gutta's*, Fig. IV. Plates C. and CI. divide the given Height into 6 Parts, give the upper 1 to the *Tenia*; divide the next 2 each into 4, give the upper one to the Fillet of the Gutta, and the next 4 to the Depth of the Gutta. The Projection of the Tenia is equal to its Height, and the Projection of the Gutta to two Thirds of the Tenia. (8) *The Height of the Cornice being given, to divide it into its Members*, Fig. II. Plate CI. divide the Height into 9 Parts, give the lower 1 to the Capital of the Triglyph, the next 1 and ½ to the Height of the Ovolo, the upper 2 to the Regula and *Cima recta*, the next 2 to the *Corona* with its Fillet, and the remaining 2 and ½ to the Modillion, with its *Cima* and *Fillet*. The Projection of the Cornice is equal to the Height, and one third Part of the Height of the Freeze. The Projection of the Cornice from the Upright of the Freeze being divided into 4 Parts, and those subdivided again, as against the Tenia is done, those Sub-divisions terminate the Projections of the other Members, as also of the *Plancere*, with its Bells or Drops, of one of the Mutules or Modillions *a, b, d, d.*

Plates C. CI. *The principal Parts of the* Dorick *Order at large, by Mr.* GIBBS,

THE Figures I. II. IV. V. VI. being already explained in the last Plates, need not be repeated here again. Figures III. and VII. are two *Dorick* Frontispieces given by this Master for Practice; of which Fig. III. having its Height divided into 11 Parts, give 1 to the Sub-plinth, 2 to the Entablature, and the Residue to the Column. The Diameter of the Column is equal to the Height of the Sub-plinth: The other Figures denote the Breadth and Height in Diameters and Parts. Figure VII. hath its Height divided into 13; of which the upper 2 go to the Height of the Balustrade, the next 2 to the Entablature, and the Remainder to the Column and its Base. *To find the Pitch of the Pediment* in Fig. III. make E D equal to E A; then make D F equal to D A, so will the Angle C F A be the angular Pitch of the Pediment required.

Plate CII. Dorick *Arcades, by Mr.* GIBBS.

HERE are two Varieties of Arches, the one without Pedestals, the other with Pedestals. That without Pedestals contains 4 Triglyphs between the Columns, and that with Pedestals contains 5. *To proportion the Arches without*

without Pedeſtals to any Height, divide the Height into 21 Parts, give 1 to the Sub-plinth, 4 to the Entablature, and the Reſidue to the Column. *To find the Height of the Top of the Impoſt*, divide the Height of the Column and Sub-plinth into 3 Parts, and the 2d is the Height required, as on the Left-hand is divided. *To proportion the Arches with Pedeſtals to any given Height*, divide the Height into 5, give the lower 1 to the Pedeſtal, (as has been already taught) and the Remainder being divided into 5, give the upper 1 to the Entablature. This done, divide the Height of the Column and Pedeſtal into 3, as on the Left Hand, then will the ſecond Diviſion from the Baſe be the Height of the Top of the Impoſt.

THE Impoſt and Architrave to theſe Arcades or Arches are repreſented by A B in Plate CIII. where you'll alſo ſee, that the Height of the Impoſt (which is always equal to the Diameter of its Pilaſter it ſtands on) is divided into 3, of which 1 is given to the Neck, the middle 1 to the Ovolo with its Aſtragal, and the upper 1 to the Faſcia and Fillet. The Aſtragal under the Neck is equal in Height to ½ the Neck. The Architrave B is generally made equal to ½ the Diameter of the Column, which Breadth being divided into 3, give three fourths of the firſt to the ſmall Faſcia, the upper 1 to the Fillet and *Cavetto*, and the Reſidue to the great Faſcia. The Projection of the Impoſt is equal to one third of its Pilaſter's Diameter, ſub-divided as in the Figure. The Projection of the Architrave is equal to five eighths of the Height of its Fillet and Cavetto, as at *a* is demonſtrated. The Meaſures of the other Parts being ſignified by the Figures affixed to each, there needs no further Explanation.

Plate CIII. Dorick *Intercolumnations for Triumphal Arches and Colonades, by Mr.* GIBBS.

THE uppermoſt Figure is a Triumphal Arch of the *Dorick* Order, whoſe Height being divided into 6, the lower 1 is given to the Pedeſtal, and the upper 1 to the Parapet; then the Remainder being divided into 5, give the upper 1 to the Entablature, and the lower 4 to the Column. The Diſtance of each Column is determined by the Figures affixed, and Height of the Impoſt, as in the preceding. *Note*, The Diameters of the Dies to the Pedeſtals in the Parapet, muſt be equal to the Diameter of the Column at its Aſtragal.

THE Intercolumnations for Portico's, or Colonades, have their Diſtances expreſſed by the Figures affixed.

Plate CIV. *The* Ionick Pedeſtal, *by* CARLO CESARE OSIO, *Geometrically deſcribed.*

BISECT X L the given Height in Y, and make the Angle X Y *c* equal to 30 deg. From X draw X *c* perpendicular to Y *c*, and thro' the Points X and *c* draw Right Lines at Right Angles to the central Line X L; then will X a be the Height of the Pedeſtal's Cornice, and equal to one eighth Part of the Whole. Make Z L equal to X a, for the Height of the Baſe.

To divide F A, *the Height of the Baſe, into its Mouldings.*

(1) DRAW the Out-lines of the Die parallel to the central Line, at the Diſtance of d z, or ¼ of the whole Height of the Pedeſtal. If the Pedeſtal be uſed ſingly without its Column, or otherwiſe, at the Diſtance equal to the Projection of the Column's Baſe. (2) Make the Angle F A B equal to 30 deg. and divide A B into 3 Parts at D C. From D raiſe the Perpendicular D *c* to cut F A in *c*, then *c* A is the Height of the Plinth. (3) Divide F A into 3 Parts at *b* E, draw *b* D, which divide into 3 Parts, then through *y*, which is the upper third Part, draw the Fillet. Biſect *b* B in H, and through H draw the

the upper Part of the *Cima recta*; the Remainder is the Aſtragal, which compleats the Heights of the ſeveral Members.

To find their Projectures.

(1) MAKE F *n* equal to F *b*, and draw *n m* parallel to F A, for the Projection of the Aſtragal. (2) Draw *n b*, and make *b n* perpendicular thereto, interſecting the upper Line of the Plinth in *b*, which determines the Projection of the Plinth. Make *b i* equal to *q r*, and that determines the Projecture of the Fillet. The Center *a* of the Aſtragal, is ſet back half the Height of the Aſtragal, and the Beginning of the *Cima recta* is from that Point as is perpendicular under it. *The Height of Z, the Cincture to the Die*, is equal to half the Height of the Aſtragal, and if *n e* be made equal to the Height of the Aſtragal, the Remainder F is the Projection of the *Cincture*.

To divide the Height of the Cornice into its Members.

(1) MAKE the Angle M F *z* equal to 30 min. and divide F *z* into 3 Parts at A B. (2) From *z* draw *z* G, dividing the Angle D *z* E into 2 equal Parts, and through the Point B draw the Line H*g* parallel to M F, cutting G *z* in *g*, through which draw *b g* E, the lower Line of the *Cima reverſa*. Divide M *b* in 3, and the upper 1 is the Height of the Fillet, and the lower 2 the Height of the *Cima*. (3) Make the Angle M F H eqnal to 60 deg. then will the Line F H cut *g* H in H, thro' which draw the Line *c* H, the under Part of the Ovolo. Biſect *g* H, and give the upper Half to the *Faſcia*, and the lower Half to the *Ovolo*, and thus are the Heights of every Member determined. Make *b*, the Projection of the *Ovolo*, equal to the Height of all the Members above the Ovolo, and draw the Line *b* M; alſo thro' the Point *b* draw the Line *p r* at Right Angles, to *b* M, by whoſe Interſections, in the Points *p*, *d*, *c*, *r*, the Projections of the Members are determined. The Drip of the *Corona* 6 5 is equal to ⅓ of the *Corona*'s Height. The Height of the Fillet F, under the Aſtragal, is equal to half the Height of the Aſtragal, and its Projection is determined by the Line *p r*.

Plate CV. *The* Ionick *Baſe and Voluta, by* CARLO CESARE OSIO.

ALTHO' the Ancients were People of great Invention, and whoſe Examples are in moſt Caſes worthy of the greateſt Regard, yet by the Compoſition of this Baſe, Fig. I. 'tis evident, that they were miſtaken in ſome Things; for ſurely nothing can be ſo monſtrous, as to ſee ſo many ſmall Members placed between a monſtrous *Plinth* and an overgrown *Torus*, and indeed, ſeemingly, as if it was intended to preſs them to pieces, inſtead of their being made Members capable to ſupport the incumbent Weight. This horrid Compoſition (for no other can I call it) is alſo followed by *Vitruvius*, *Barozzio*, *Serlio*, *Cataneo*, *Barbaro*, *Viola*, *De Lorme*, *Bullant*, *Perault*, and *Julian Mau-Clerc*, whilſt *Palladio*, *Scamozzi*, and the other Maſters, have abhorred it. Its Height is equal to the Semi-diameter of the Column, and its Members are divided as follow, (1) The Height of the Plinth is one third part of the Height of the Baſe, and its Projection is determined by the Line *a w*, making the Angle *w a z* equal to 30 deg. (2) Make *f g*, the Height of the Scotia's and Aſtragals taken together, equal to *w g*, the Projection of the Plinth, then will *a f* be the Height of the *Torus*. Make *a c* equal to *a f*, and draw *c e* parallel to *a z*; make *c b* and *e l* each equal to half the Height of the *Torus*, and biſect it in *d*, the Center, on which deſcribe the Semi-circle. (3) Biſect *f* 9 in 4, the Diviſion of the two Aſtragals, and draw the Line *w f*, which interſect in the point *p*, by the Line *p* 9, making the Angle *p* 9 *w* equal to 30 deg. then thro' the point *p* draw the Line *p* 5, the under part of the lower Aſtragal. (4) The Fillets 5 6 and 8 9 are each one eighth of 5 9. (5) Make 2 4, the Height of the upper Aſtragal, equal to 4 5, the Height of

of the lower Aſtragal, and the Fillets $f\,g$ and 1 2, equal to $\frac{1}{8}$ of f 2. The Projection of the Fillet under the Torus is determined by $b\,l$ continued, the Fillet m 1, by the Interſection of the Line $a\,w$ in the Point m; the two Aſtragals by the Torus $c\,e$ continued, the Fillet p 5 by the Interſection of the Line $f\,w$ in the Point p. (6) Divide the Height of each *Scotia* into 3 equal parts, as h and 7, and draw the Lines $i\,h$, and r 7, on which will be found the Centers for to deſcribe the Curves of the Scotia's as follows, *viz.* Continue $l\,k$ to n, then is n the Center of the leſſer Quadrant; then taking the Height h 1 in the Compaſſes, ſet that Diſtance on the Line $i\,h$, from the Point where the leſſer Quadrant meets it, unto i, then on i deſcribe the greater Quadrant, which will compleat the upper *Scotia*; and if in like Manner you form the lower *Scotia*, the whole Baſe will be compleated as required.

To deſcribe the Ionick *Capital,* Plate CV.

(1) DIVIDE the given Height 1 13 (which is always equal to two thirds of the Height of the Baſe) into 13 equal Parts, give 1 to the upper Fillet, 2 to the Cima reverſa, 1 to the Liſt of the Volute, 3 to the Faſcia, and the reſidue 5 to the Ovolo; continue on downwards, and make the Aſtragal equal to 2, and its Fillet to 1 of thoſe Parts, and ſo are the Heights of all the Members determined. *To determine their Projectures* before the Line $e\,t$ (which being continued downwards is the Upright of the Column) make $e\,b$ equal to 1 5, and $c\,b$ equal to 1 2, then from b draw $b\,h$ parallel to $e\,t$, which terminates the Fillet; draw the Line $c\,f$, cutting the Liſt of the Volute in x and l, and then making $g\,h$ equal to a fourth Part of $b\,h$, draw $x\,g$, and deſcribe the *Cima reverſa.* Thro' the Point l, where the Line $c\,f$ cuts the Line 5 l, draw the Line $d\,l$ A F w, &c. continued on at Pleaſure, interſecting the upper Line of the Aſtragal in w, the Center of the Volute; from 7 draw the Line 7 m parallel to 8 $t\,q$, which will cut the Line $d\,l$A, &c. in the Center of the Quadrant $l\,m$, and then $m\,q$ being drawn parallel to $e\,t$, the Mouldings of the Capital will be compleated as required.

To deſcribe the Voluta.

(1) DRAW 13 V w, the upper Line of the Aſtragal, out at Pleaſure, as on to P, &c. alſo continue downwards the Line d A w, as unto 9 $\frac{3}{4}$, &c. alſo draw the Lines B w 10 $\frac{1}{2}$, and M w 8 $\frac{15}{16}$, cutting each other at Right Angles, and at 45 deg. Diſtance from the Lines A w and W w, which continue out both Ways at Pleaſure: This done, apply to your 15 equal Diviſions, by which you divided out the Heights of the Members of the Capital, and ſub-divide them into 3 Parts, of which every 2 will be equal to $\frac{1}{60}$ Part of the Diameter of the Column, and equal to 1 min. (2) Of theſe Minutes make w M equal to 11 $\frac{15}{16}$ and w N equal to 10 $\frac{9}{16}$; alſo make w P equal to 11 min. $\frac{7}{16}$, and w O to 9 min. $\frac{15}{16}$: This being done you have the three Points x, M, P, given to deſcribe the Arches x, M, P, and the three Points l, N, O, given to deſcribe the Arch l N O. Proceed in like Manner with every other Quadrant, ſetting off the Diſtances from the Center, as ſignified by the Figures affixed, and Arches being deſcribed to paſs through every 3 of them, will compleat the Volute, as required. This Volute hath the moſt eaſy and gradual Diminution of any that I have yet ſeen, and the Rule being the moſt eaſy, I do therefore recommend it before all others that follow, which in general are infinitely deficient of the graceful Curvature and eaſy Diminution of the Liſt.

Plate Z to follow Plate CV. Ionick *Volutes of various Kinds.*

METHOD I. The Figures C and D repreſent an ancient Method of deſcribing the *Ionick* Volute, which *Barozzio* of *Vignola* and many others have followed, altho' the Liſt is far from having an eaſy Diminution.

 To

To underſtand this Method, 'twill be beſt to have Recourſe alſo to Plates CXXVI. CXXVII. where this Volute is deſcrib'd more largely in Fig. I. there you ſee, that where the perpendicular Line 8 A 6 (which is called the *Cathetus*) interſects the upper Line of the Aſtragal, that is the Center of the Eye of the Volute. *To find the Radius or Diameter of the Eye of the Volute*, divide the upper Part of the Cathetus, from the Center of the Eye, to the under Part of the *Cima reverſa*, into 9 equal Parts, and make the lower 1 the Radius of the Eye, with which deſcribe the Circle. To find the Depth of the Volute on the Cathetus below the Eye, make that Part equal to 6 of the Parts above; this done let the Line 1 5, in Fig. D, Plate Z, repreſent the Cathetus, and the Line 3 7 the upper Line of the Aſtragal, and let their Point of Interſection be the Center of the Eye of the Volute, on which let the Eye be deſcribed; alſo draw the Lines 2 6 and 4 8 through the Center of the Volute at Right Angles to each other, and at 45 deg. Diſtance from the Cathetus 1 5, and horizontal Line 3 7, on which, and on the Cathetus and horizontal Lines, the Limits of the Volute muſt be determined as follows, *viz.*

(1) DRAW *b c* in Fig. C (on the Left Hand) at Pleaſure, and at its End *b* erect the Perpendicular *b a*, of Length at Pleaſure. (2) Take the Radius of the Eye of your Volute in your Compaſſes, and on the angular Point *b* deſcribe a Circle. Make the Height *e a* equal to 4 times the Diameter of the Eye; alſo make *b c* equal to 3 Diameters and half, and draw the Hypothenuſe *a c*. (4) On *c*, with the Radius *c b*, deſcribe the Arch *b e d*, and draw the Line *e c*. (5) Divide the Arch *e d* into 6 Parts, and ſub-divide each Part into 4 Parts, then will the Arch *e d* be divided into 24 equal Parts. (6) Lay a Ruler from *c* to every of thoſe Parts, and it will divide the Line *a e* into 24 unequal Parts, by which the Curve of the Volute is determined as follows, *viz.* The Diſtance from the Center of the Volute to 1, the upper Point of the Cathetus, in Fig. D, being equal to *b a* or 6 1 in Fig. C; therefore ſet

b 2	&c. in Fig. C, from the Center of the Eye of the Volute in Fig. D, unto the Point	2	&c. thro' which the Contour, or Curve of the Volute muſt paſs, as following, *viz.* (1) Set one Foot of the Compaſſes in the Center of the Volute, and extend the other to the Point 1, then with that Radius on the Points 1 and 2,
b 3		3	
b 4		4	
b 5		5	
b 6		6	
b 7		7	
b 8		8	

deſcribe Arches interſecting each other, on which Point of Interſection deſcribe the Arch 1 2. (2) Set one Foot of the Compaſſes in the Center of the Volute, and extend the other to the Point 2, then, with that Radius, on the Points 2 and 3, deſcribe Arches interſecting each other, on which point of Interſection deſcribe the Arch 2 3: In like Manner proceed with all the remaining Points, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, till the Whole is compleated. The inward Line of the Liſt of this Fillet is carried, for the greateſt Part, at a parallel Diſtance, which has a very ill Effect; and therefore to diminiſh it gradually is a Work which none of theſe Maſters have taught, and may be eaſily effected as follows: Divide the Height of the Liſt at 1 into 24 equal Parts, and

from the Point	2	ſet towards the Center	23	Parts;
	3		22	
	4		21	
	5		20	
	6		19	
	7		18	
	8		17	
	9		16	
	10		15	
	11		14	
	&c.		&c.	

and

and then, thro' these last produced Points, describe the inward Curve, by the same Rule as you did the outward Curve, and that will compleat the Voluta, diminished in an easy agreeable Manner, as it ought to be done.

METHOD II. *To describe the* Ionick *Voluta by Means of* 24 *Centers, differently from the preceding*, Fig. H, Plate Z.

(1) DRAW the Cathetus *p* 4, and let the Height *p* 4 be the given Height of the Voluta. (2) Divide the given Height into 8 equal Parts, as by the dotted Lines 7 7, 6 6, 5 5, *&c.* is done, and let the fifth Division 4 3 be bisected in *g*, from whence draw the Line *g d*, and its Point of Intersection, with the Cathetus, is the Center of the Eye of the Volute: The Diameter of the Eye is equal to the fifth Division, or $\frac{1}{8}$ of the whole Height: Within the Circle of the Eye inscribe a Geometrical Square, as before in the last Example, drawing its Diameters through the Center, and dividing them each into 6 equal Parts. This done number the several divided Points in the Diameters of the inscribed Square, as is done in Fig. K, which represents the Eye of the Volute more at large, as 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12; these 12 Points are the Centers on which the outward Line of the Volute is described, as follows, *viz.* (1) From the Point 1 draw the Line 1 *q* parallel to the Cathetus. (2) Continue 1 2 to *k*, and on 1, with the Radius 1 *q*, describe the Quadrant *q k*. (3) Thro' the Points 2 and 3 draw the Line 2 3 *c* parallel to the Cathetus, and on the Point 2, with the Radius 2 *k*, describe the Quadrant *k c*. (4) Through the Points 3 4 draw the horizontal Line 3 *l*, and on the Point 3, with the Radius 3 *c*, describe the Quadrant *c l*. (5) Through the Points 4 5 draw the oblique Line 4 5 *u*, and on the Point 4, with the Radius 4 *l*, describe the Arch *l y u*. (6) Thro' the Points 5 6 draw the Line 5 6 *r*, and on the Point 5, with the Radius 5 *u*, describe the Arch *u r*. (7) Through the Points 6 7 draw the Line 6 7 *s*, and on the Point 6, with the Radius 6 *r*, describe the Arch *r s*. (8) Through the Points 7 8 draw the Line 7 8 A, and on the Point 7, with the Radius 7 *s*, describe the Arch *s* A. (9) Through the Points 8 9 draw the oblique Line 8 9 *w*, and on the Point 8, with the Radius 8 A, describe the Arch A *w*. (10) Thro' the Points 9 10 draw the Line 9 10 *x*, and on the Point 9, with the Radius 9 *w*, describe the Arch *w x*. (11) Thro' the Points 10 11 draw the Line 10 11 *i*, and on the Point 10, with the Radius 10 *x*, describe the Arch *x i*. (12) Thro' the Points 11 12 draw the Line 11 12 &, and on the Point 11 describe the Arch *i* &; *lastly*, on the Point 12, with the Radius 12 &, describe the Arch & *h*, which compleats the Contour as required. *Note*, The inward Line must be diminished, as in the last Example, but with this Difference, that whereas in that you divided the Height of the Fillet into 24 equal Parts, it having 8 Lines that terminated the Arches, so here, where in Effect there are but 4 Lines which terminate the Arches, the Height must be divided into 12 equal Parts, and therefore 1 Part must be abated at the Termination of each Arch. The Centers to these inward Arches may be found by Intersections, as in the preceding Example.

IT is to be noted, that the nearer the Centers are together the more circular the Volute is, as in Fig. D and H, and the more distant they are, as in Fig. F, G, I, the more elliptical they are. Fig. B represents at large the Manner of placing the Centers of Fig. G. Fig. L is no more than a Repetition of Fig. K, inserted by Mistake of the Engraver. Fig. N represents the Volute Fig. H, but as if it were pressed elliptically, it having the same respect to the Parallelograms made by the dotted Lines, as the Volute Fig. H hath to the dotted geometrical Squares. *The Manner of describing these elliptical Volutes* is as follows, Suppose the given Height be *e a* and Breadth *b a*; (1) It is to be observed, that the Height and Breadth of the circular Volute, Fig. H, are to one another as 8 is to 7, that is, 8 Squares in Height by 7 Squares in Breadth; this being understood, divide *e a*, the given Height of your elliptical Volute Fig. N, into 8 equal Parts, and its Breadth into 7 equal Parts, and compleat

compleat the dotted Parallelograms. (2) Compleat a circular Volute, as Fig. H, making its Height equal to the Height of the elliptical Volute. (3) Obferve to trace the elliptical Curve through the Parallelograms, in the very fame Manner as the circular Volute paffeth through the geometrical Squares, and that will compleat the elliptical Volute, as required.

FIG. E, on the Head of the Plate, reprefents the Centers at large of Fig. I. which being nearer together than Fig. B, the Volute Fig. I, is lefs elliptical than the Volute Fig. G. The Manner of defcribing thefe Volutes are the very fame as the other before delivered, that is, the Volute Fig. F is by the fame Rule as Fig. D, and the Volutes G I the fame as Fig. H.

FIG. M *is the Manner of defcribing the Eye of the Volute, according to the Invention of Mr.* NICHOLAS GOLDMAN, *as follows.*

(1) LET the Circle *g* 2 4 reprefent the Eye of the Volute, let the Line *p* 4 be the Cathetus, and *g d* c[illegible] at Right Angles in the Center of the Eye. (2) Let the Points 1, 4, [illegible]ide the two Semidiameters into 2 equal Parts, and confequently the [illegible] be equal to the Semidiameter of the Eye. (3) Compleat the geometrical [illegible]re 1 2 4 3, and from the angular Points [illegible]he Eye. (4) Divide the Side of the Square 1 [illegible] at [illegible]nts 5, 9, 12, 8, and draw the Lines 5 6, 9 10, 12 11, 8 7, parall[illegible] Line *g d*. (5) Draw occult Lines in three Sides of the Eye, as in the pre[illegible]ing, which with the Cathetus *p* 4 (that terminates the Arches, inftead of [illegible]e Lines *q u w*, as in Fig. K) will terminate every Arch contained in the Volute, which are to be defcribed on the Centers 1, 2, 3, 4, *&c.* as thofe in Fig. H.

P. *Pray from whence is the Word* Voluta *derived?*

M. THE Word *Voluta*, or Scrowl, is from the *Latin, Voluta à volvendo,* for that it feems to be rolled upon an Axis or Staff: *Alberti* calls them Snail-Shells from their fpiral Turn; it is the principal and only appropriate Member of the *Ionick* Capital, which has *four*, in Imitation of a Female Ornament. The Face is called the *Frons*, or Forehead, a little hollowed between the Edge or Lift; and the Return, which the next Plate exhibits, is called *Pulvin* or *Pillow*, betwixt the Abacus and Echinus or Ovolo, refembling the fide-plaited Treffes of Women's Hair, to defend as it were the Ovolo from the Weight of the Abacus (over which the Voluta is placed.) The Eye of the Volute is, by fome, from the *Latin*, called *Oculus*.

P. *Pray why is this Order called* Ionick?

M. BECAUSE it was invented by *Ion*, when he was fent from *Athens* with a Colony into that Part of *Greece* bearing his Name (and where he erected a Temple to *Diana* the Goddefs, whofe Columns were of ftupendous Magnitude, but made of greater Altitude, with refpect to their Diameter, than the *Dorick*, as being more fimilar to feminine Slendernefs; not like a light Houfewife, as *Vitruvius* compares it, but in a decent Drefs, hath much of the Matron; and to make it ftill the more feminine, its Shaft was enriched with its 24 Flutes, and as many Fillets, alluding to the Folds and Plaits of Garments, of which I have already taken Notice.

Plate CVI. *The Profile or Pillow of the* Ionick *Volute.*

(1) THE Abacus *r p m v* being firft drawn, as before taught, together with the Ovolo *w*, and Aftragal *x z* 2, admit the Line *c a* 15 to be the central Line of the Capital. (2) Make *a* 22 equal to *a c*, and then *a* 22 divided into 3 Parts, the outer one on the Right is the Fillet, and the other 2 the Band. (3) Make *k l* equal to I *k*, and draw *l* 19 for the upper Line of the Pillow; alfo divide *z* 2, the Height of the Fillet to the Aftragal, into 5 equal Parts, and

and from the lower 1 draw the Line 1 5 7 13 for the lower Line of the Pillow. The Depth of the Volute *m* 3 is determined from the Volute itſelf, and the Breadth of the Liſt *t k* is equal to *k l*. (4) Make *r q* equal to *r p*, biſect *r p* in *o*, and from *q*, through *o*, draw the Line *q h* 15, cutting the Line *l* 19 in the Point *h*, and the Bottom of the Ovolo in the Point 15: On *k h*, with the Diſtance *k h*, deſcribe the Curve *k h*. (5) From the Point 13 draw the Line 13 10, making the Angle 10 13 12 equal to 30 deg. cutting the Line *x* 12 in 10; from the Point 10 draw the Line 10 21 parallel to the Line 22 18, cutting the Line *l* 19 in the Point 21, at which Point the Curve begins; the other Point, where the ſame Curve ends in the Line 22 18, is the ſame Diſtance from 19 as *f* is from 22; the Arch is deſcribed equilaterally, as the former. (6) Make 13 7 equal to 10 12, and ſet ¼ of 13 7 on the Line 22 13, from 13 towards 12, in which Point the Arch will terminate, and which is to be deſcribed equilaterally as the former; *laſtly*, the Curve 5 4 is deſcribed on a Center, whoſe Diſtance from the Point 4 is equal to the Diſtance 1 4, on the Line 3 4 continued.

Plate CVII. *The* Ionick *Entablature geometrically deſcribed according to the Ancients, by* CARLO CESARE OSIO.

THIS Entablature is rather of too rich a Compoſition for the *Ionick* Order, and particularly its Architrave, which would have been better had it been broke into two Faſcia's inſtead of three, which is more proper for the *Corinthian* or *Compoſite* Order. *To divide the Height of the Entablature a s into its Architrave s* C, *Freeze* C *r, and Cornice r a.* (1) From the Points *a* and *s* draw the Lines *a* A and A *s*, each making an Angle of 30 deg. with the Line *a s*, and interſecting each other in the Point A. (2) Divide A *s* into 3 equal Parts at D E, and from the Point D draw the Line D F at Right Angles to *a s*. (3) Divide F *s* into 6 equal Parts, and give the lower 5 C *s* to the Height of the Architrave. (4) Biſect *a* C, the Height of the Freeze and Cornice, in the Point *r*, then C *r* is the Height of the Freeze, and *r a* the Height of the Cornice. *To divide the Architrave into its Tenia and three Faſcia's.* (1) Draw *a s*, making the Angle C *s a* equal to 30 deg. alſo from the Point *a* draw the Line *a m*, making the Angle C *a m* equal to 20 deg. then will *m* C be the Height of the Tenia: Divide C *m* into 3 equal Parts, and give the upper 1 to the Fillet, and lower 2 to the *Cima reverſa*. (2) Biſect *l s* in *q*, then is *m* 9 the Height of the upper Faſcia, and one fourth Part of *m s* is the Height of the lower Faſcia 3 *s*. *To determine the Projecture of the Architrave*, biſect *a s* in 2, on which erect the Perpendicular 2 *n*; from *n* draw *n i* parallel to *a s*, cutting *m a* in *i*; from *i* draw *i k* parallel to *n* 2, cutting C *s* in *k*: On *m*, with the Radius *m k*, deſcribe the Quadrant *k g*: Divide *g m* into 6 equal Parts, let *h p* project 3 and half of thoſe Parts, and *o r* one half Part thereof: The Projection of the *Cima reverſa* is always equal to its Height. *To find the Swelling of the Freeze*, make *r* C the Radius, on C deſcribe the Arch *r* B, and on *r* the Arch C B, then is the Point B the Center, on which, with the ſame *Radius*, deſcribe the Swelling of the Freeze required. *To divide the Cornice into its Mouldings.* (1) Divide the Height *a r* into 3 equal Parts, as is done by the 3 dotted Semicircles, of which the lower one determines the Height of the Dentils and *Cima reverſa* under them. (2) From the Point 3 draw the Lines *b* 3 and *i* 3, the firſt making the Angle *b* 3 *a* equal to 30 deg. and the latter making the Angle *i* 3 *a* equal to 60 deg. Biſect *b* 3 in *f*, and from *f* draw *f g* at Right Angles to *b* 3, cutting *i* 3 in the Point *g*, thro' which draw the Line 27 5 for the Bottom of the Fillet under the great Cima. (3) Divide *a b* into 5 equal Parts, and give the upper 1 to the Regula, or upper Fillet. (4) Make *b e* equal to *b d*, then is *b e* the Height of the ſmall Cima, and the Height of the Fillet over it is equal to one fourth Part of its own Height. (5) Biſect 6 12 in 8, and draw 8 *m* 24 for the lower Part of the Fillet to the *Ovolo*. (6) Divide *e m* into 6 equal Parts, then the lower 1, *l m*, is the

 Height

Height of the Fillet aforesaid. (7) Make *l n*, the *Ovolo*, with its *Fillet* included, equal to *l e*, the Height of the *Corona*, and draw the Line 1 *n* 9. (8) Draw the Line *i r*, making the Angle *i r a* equal to 30 deg. which bisect in *k*, and then dividing *k r* into 4 Parts, the lower 1, that is 14 *r*, determines the Height of the lower *Cima reversa*; also thro' the upper 1, at the Point 10, draw the Line *z* 10 for the central Line of the Astragal under the Ovolo. (9) From the Point *k* draw the Line *k y* parallel to the Line *a r*, which will cut the Line *z* 10 in the Point *z*, the Center of the Astragal; divide the Distance from the central Line of the Astragal to *m* into 7 equal Parts, and give the lower 1 to the upper Half of the Astragal, also make the under Half of the Astragal, and the Fillet under it, each equal thereto; *lastly*, Make the Height of the Fillet under the *Dentils* equal to one sixth Part of their Height, and thus are the Heights of every Member determined. *To determine their Projectures*, (1) Make 64 7 equal to 64 *r*, and draw 7 *v*, the Face of the Fillet under the Dentils; make 64 *q* equal to 64 5, and from the Point 5 draw the Side of the Dentil parallel to *r a*, until it meets its own Fillet; make 7 *w* equal to 7 5, and draw *w x*; bisect the first Dentil *w* 7 in the Point 8, and make the Distance between every Dentil equal to *w* 8, that is, every Interval must be equal to half the Breadth of a *Dentil*, and every Dentil equal to *w* 7. (2) The Line *z y* being before drawn from *k*, let it be continued to meet the Line 17 8 in the Point 15, which is the Center of the Ovolo, whose Fillet 18 17 hath its Projection equal to its Height. (3) Make *a* 31, the Projection of the Cornice, equal to *a r* its Height, and draw 31 30, the Face of the *Regula*: From the Point *i* draw the Line *i* 19 parallel to *a r*, and make the Projection of the Fillet between the two Cima's, before the Line *i* 19, equal to its own Height, deducting the upper Cima and its Regula only. (4) Draw the Line 30 19, cutting the upper Part of the *Corona* in the Point 25, from whence draw the Face of the *Corona* 26 24; bisect 24 19 in 20, and on 20, with the Radius 20 22, describe the Quadrant 22 21; *lastly*, describe the two Cima's, and the whole Entablature is compleated as required.

Plate CVIII. Ionick Orders *taken from the Theatre of* MARCELLUS, *and Temple of* MANLY FORTUNE *in* Rome, *by* PETER TIBURTINE.

FIG. I. represents the *Ionick* Order in the Theatre of *Marcellus* at *Rome*, whose entire Height A C being divided into 13 equal Parts, the upper 3 is given to the Height of the Entablature, and the lower 10 to the Column, with its Base and Capital. *To find the Diameter of the Column* is a Work of some little Difficulty, seeing that the Height of the Column is 8 Diameters and $\frac{3}{5}$, which compels us to divide the Height of the Column into 43 Parts, and take 5 of them for the Diameter. Fig. II. represents the *Ionick* Order in the Temple of *Manly Fortune* in *Rome*, whose entire Height A B being divided into 8 equal Parts, as on the Right Hand, the Entablature possesses the upper 1 and $\frac{2}{16}$ of the 2d, as *a b*, and half *b c*; the Height of the Column is 8 Diameters and $\frac{1}{4}$, and to find the Diameter we must divide its Height into 33 equal Parts, and take 4 of them for the Diameter.

IT is here to be observed, that the Ancients did not confine themselves to certain Rules in their Orders, but added to them or diminished them, as the Situation and Place required, but then it was always with the utmost Circumspection and greatest Judgment imaginable, which must be always observed when we depart from established Rules.

Plate CIX. *The Base, Capital and Entablature at large of the Theatre of* MARCELLUS *at* Rome.

THE several Parts of this Order are determined by equal Parts, as (1) The Base, whose Height is equal to the Semidiameter of the Column, is divided into 3, of which the lower 1 is the Height of the Plinth, the remaining 2 being divided into 3, the lower 1 is the Height of the Torus, the middle 1 the Scotia and its lower Fillet, and the upper 1 the upper Torus and under Fillet; the Height of the Fillets is $\frac{1}{6}$ of the Scotia; the Base of the Column being divided into 12, the Out-lines of the upper Part of the Shaft, standing over the Points *o p*, shews that its Diminution is $\frac{1}{6}$; the Height of the Entablature being divided into 10 Parts, as *a b*, give 3 to the Architrave, as many to the Freeze, and the upper 4 to the Cornice, then sub-divide each as the Divisions exhibit.

Plate CX. *The Base, Capital and Enatblature at large of the* Ionick Order, *in the Temple of* MANLY FORTUNE *at* Rome.

THE several Parts of this Order are also determined by equal Parts, as the preceding Example. *The Height of the Base* is equal to the Semidiameter of the Column, and that of the Capital unto two third Parts thereof. *The Height of the Entablature* is two Diameters and $\frac{1}{14}$ of a Diameter. The Height of the Architrave is equal to the Semidiameter of the Column, as also is the Freeze; but the Height of the Cornice is equal to both their Heights, and a fourteenth Part more, as before observed. The principal Parts being thus divided, the particular Members have their Heights determined by the Sub-divisions, which a little Inspection will make plain.

REMARKS.

THO' these two Examples are of the Ancients, yet sure it is, that nothing can be so monstrous as the upper Parts of both these Entablatures.

IN that of *Marcellus* there is a very small and poor *Cymatium* set upon a large and noble *Corona*, and that of *Manly Fortune* has a monstrous Cima recta on a small Cima reversa, and those placed on a poor and low decrepid *Corona*, scandalous to behold.

THE Bed-mouldings to both these Examples are not amiss, nor is the Freeze of *Marcellus* so liable to Censure as that of *Manly Fortune*, which seems to be much too low for the Cornice over it, and more especially as that the great Projection of the Tenia to the Architrave doth cause it to appear much lower than it really is.

Plates CXI. CXII. *Profiles of the* Ionick Orders *in the Theatre of* MARCELLUS, *and in the Temple of* MANLY FORTUNE *in* Rome, *by Mr.* EVELYN.

THE Profile on the Left is that of the Theatre of *Marcellus* (not of the Temple of *Manly Fortune*, as it is by the Engraver mistakenly expressed.) This and the other Profile, which is of the Temple of *Manly Fortune*, differ very greatly in their *Corona's* and *Cymatiums*, from the preceding Examples, and which I believe have been altered by Mr. *Evelyn* himself; for in that of *Marcellus* there is a poor trifling Corona, which in the preceding Example hath a very large and grand one; and in that of *Manly Fortune* there is a Corona of a noble Aspect, which in the other Example is very low and disproportioned: On the Right Hand of this Plate is the Portico to this Temple, which

which is now called *the Temple of St. Mary the Egyptian,* and is one of the moſt beautiful Portico's of the Kind that the Ancients ever erected; the Parts of both theſe Profiles are determined by Minutes, accounted from the central Line.

Plate CXIII. *The* Ionick Order *in the Bath of* DIOCLESIAN *in* Rome.

HERE this Order is repreſented, as well perſpectively as in its geometrical Elevation, where its Members are determined by Minutes: The Temples *Diaſtyle* and *Syſtyle* are according to *Vitruvius,* whoſe *Ionick* Orders come next in courſe.

Plates CXIV. CXV. *Two Examples of the* Ionick Order, *by* VITRUVIUS.

FIG. I. is the firſt Example, whoſe Column and Entablature being divided into 8 Parts, the Height of the Entablature is 1 Part, and $\frac{5}{16}$ of a Part, and the remaining 6 parts and $\frac{11}{16}$ is the Height of the Column, which being divided into 8 parts, as on the Left, one of thoſe 8 parts is the Diameter of the Column. Fig. III. repreſents the parts of this Order at large; the Baſe is of that horrid Compoſition which I have already taken Notice of, whoſe Height is equal to the Semidiameter of the Column, and whoſe Members are ſub-divided, as by the Diviſions appear.

THE Height of the Capital is equal to $\frac{1}{4}$ of $\frac{1}{8}$ of the Column and Entablature; the upper eighth part of the entire Height in Fig. I. being divided into 8 parts, give the upper 4 to the Height of the Cornice, and the next 3 to the Height of the Freeze, then ſub-divide the Architrave firſt in 7 for to find the Tenia, and afterwards in 12 to divide the Faſcia's: The Height of the Cornice ſub-divide into 9, and give each Member its Height, as expreſſed in Fig. III.

FIG. II. is his ſecond Example, which is much better regulated than the other; in this the entire Height is divided into 5 parts, of which the Entablature is one, which is directly the *Dorick* Proportion, the lower 4 being the Height of the Column divide it into 8 parts, and take 1 for the Diameter: The Height of the Baſe to this Order is equal to the Semidiameter of the Column, and it is compoſed of the ſame Members as the other Example; but the Torus of this is not quite ſo monſtrous, nor are the Aſtragals ſo very ſmall as thoſe of the other. We may alſo obſerve, that in this Example *Vitruvius* has divided the Semidiameter of the Column into 12 parts, and conſequently the Whole into 24; of theſe parts he makes the Height of the Architrave equal to 13, and Height of the Freeze to 12 $\frac{1}{4}$, which being taken out of two Diameters (which is the Height of the Entablature) the Remainder is the Height of the Freeze: The Height of the Capital is equal to 7, excluſive of the Aſtragal, which is equal to 2; the particular Members are ſub-divided according to the Diviſions annexed.

REMARKS.

IF we conſider the very ſmall *Cima reverſa* under the great *Cima recta* in Fig. III. and the ſmall Cymatium over the Corona in Fig. V. it cannot be ſaid that either of theſe Cornices are good, altho' they are the Compoſition of ſo great a Maſter.

Plate

Plate CXVI. *The* Ionick *Voluta, by* VITRUVIUS.

THIS Voluta of *Vitruvius* is deſcribed by Method II. in Plate Z, after Plate CV. whoſe Height is equal to 8 times the Diameter of its Eye, as is ſeen on the Cathetus P D, or rather of the Height of the Aſtragal, to which the Eye of the Volute is made equal, and on whoſe central Line its Center is placed, as at O.

THE Fig. H repreſents the Eye of the Volute with an inſcribed Square, whoſe Diameters are each divided, as I have already ſhewn, into 6 Parts, which gives the 12 Centers for deſcribing the Out-line of the Volute, and then each of thoſe 6 parts being ſub-divided into 4 parts, the upper 1 of each part will be 12 other Centers, on which you may deſcribe the inward Line of the Volute with a graceful Diminution. The 24 Centers of this Eye are each numbered as they are to be employed.

FIG. K is the Eye of a Volute, for turning about the Contour by 6 Centers, which are found by dividing its Diameter into 6 equal parts at the Points 3, 5, 6, 4; the other Points 7, 9, 11, 12, 10, 8, are 6 other Centers for deſcribing the inward Line, each being one fourth Part of the firſt: The Cathetus 1 2, is the only Line at which every Arch terminates, and therefore they are all Semicircles. The Volute thus produced is very agreeable, its Diminution very eaſy, and the Method very plain.

FIG. W is a Duplicate of Fig. H, inſerted by the Engraver's Miſtake. Fig. V is the Manner of dividing the Eye of the Volute into its Centers, according to Mr. *Goldman*'s Invention, Fig. M, Plate Z, after Plate CV. But as Mr. *Goldman* only gave us the 12 Centers for the Contour or Out-line, here are 24, *viz.* 12 for the Out-line and as many for the Inward-line, which laſt are found by dividing each of the 6 parts of 1 4 into 4 parts, as in the Figure is exhibited, and the laſt one from the Center of every ſuch Sub-diviſion, as the Points 13, 17, 21, 24, 20, 16, are the Points from which you are to draw Lines parallel to the former, until they cut the oblique Lines in the Points 14, 18, 22, 15, 19, 23, which, with the aforeſaid, are the Centers required for the Inward-line. Fig. X is a Side-view of the Volute, with its Pillow enriched.

Plates CXVII. CXVIII. *Divers* Ionick *Portico's, by* VITRUVIUS.

THIS Plate contains the geometrical Plans and Elevations of the three different Kinds of *Ionick* Portico's, as *firſt*, the Temple *Euſtile* of four; *ſecondly*, Fig. B of ſix; and *laſtly*, Fig. A of eight, which laſt is the Temple of *Diana* at *Epheſus*, and the firſt Example of this Order. On the Left Hand is an *Ionick* Door by *Vitruvius*, which with the Portico's is given here by Way of Example for the Practice of young Students.

Plate CXIX. Ionick *Temples, by* VITRUVIUS.

THE Plans of the Portico's to theſe two Temples are exhibited in the laſt Plate, which, together with theſe Elevations, are given as further Examples for Practice.

Plates CXX. CXXI. *The* Ionick Order, *by* A. PALLADIO.

THIS Plate compriſeth all the *Ionick* Meaſures of the Pedeſtal, Column, Entablature, Impoſts, Arcade and Intercolumnation, which in general are determined by Modules and Minutes; Fig. I. repreſents the Entablature, which is a fine Compoſition of Mouldings, wherein the Dentils are excluded, and plain Modillions introduced. The Freeze is ſwelling, and ſeems to be cauſed by

the Weight of its Cornice in manner of a Cuſhion preſſed. The Architrave is no wiſe leſs noble than is the Capital; though I muſt again obſerve, I cannot think but that the Architrave in this Order would be more noble, did it conſiſt but of two Faſcia's, and more eſpecially when 'tis placed over the *Dorick*, and the Architrave of the *Dorick* conſiſts but of one *Faſcia*, excluſive of the *Tenia*. The Aſtragal under the Cincture is a pretty additional Member, making the *Attick* Baſe under it, ſomething more rich, than before in the *Dorick*. Figure II. is the Pedeſtal, wherein there are two Examples for the Mouldings of its Cornice and Baſe, which are very good. Figure III. is the Volute of the Capital, which is deſcribed by Method II. Plate Z. Figure IV. is a Plan of one quarter Part of the Capital, with the Manner of dividing the Flutes and Fillets of the Neck of the Shaft, and the Swelling of each Cabling. The Manner of *dividing the Shaft* is, to divide its Circumference into 24 equal Parts, and ſub-dividing each Part into 4, give 1 to a Fillet, and 3 to a Flute. To find their Depth, divide each Flute into 2, and deſcribe Semicircles for their Depths. To find the Swelling of the Cablings, take the Breadth of a Flute in your Compaſſes, as *b c*, and make the Section *a*, on which, as a Center, deſcribe the Curve *e b*, which is the Swelling of the Cabling required. Figure V. is a moſt beautiful Impoſt and Architrave for the Arch. Figure VI. is another Impoſt of good Compoſition alſo. Figure VII. is his Intercolumnation for Colonades or Portico's. The Height of the Pedeſtal is 2 diam. 37 min. the Height of the Column 9 diam. and the Height of the Entablature 1 diam. 50 min.

		Diam.	Min.
The Height of the	Pedeſtal and Column	11	37
	Column and Entablature	10	50
	Pedeſtal, Column and Entablature	13	27

Plate CXXII. *The* Dorick *Order, by* V. SCAMOZZI.

THE Meaſures, by which the Members of this Order are determined, are Modules and Minutes, as expreſſed in the Plate. The Compoſition of the whole Order taken together is, I think, too rich, excepting the Inſide Works, where the Eye cannot be removed very far from it. The Contrivance of placing the Volutes in a Diagonal View, as expreſſed by Figure D in Plates CXXIII. CXXIV. is much preferable to the ancient Method of placing them in a direct View; and their being made of an elliptical Form, is a Means of preventing their foreſhortening too much, when viewed very near. The other Parts being obvious, I need to ſay no more as to their Particulars; and therefore I ſhall proceed to the general Parts, wherein 'tis to be obſerved, (1) That the Module, by which they are meaſured, is the Diameter of the Baſe of the Column. (2) That the Height of the Pedeſtal is 2 mod. 30 min. (3) The Height of the Baſe to the Column $\frac{1}{2}$ mod. the Height of the Column, including its Baſe, Shaft and Capital, 8 mod. 45 min. the Height of the Capital 18 min. $\frac{3}{4}$; the Height of the Entablature 1 mod. 45 min. the Diminution of the Shaft is 10 min. or $\frac{1}{6}$ of the Diameter.

		Mod.	Min.
The Height of the	Pedeſtal and Column	11	25
	Column and Entablature	10	30
	Pedeſtal, Column and Entablature	13	00

Plates CXXIII. CXXIV. *Two* Ionick *Frontiſpieces, with Impoſts, by* V. SCAMOZZI.

FIGURE A is an *Ionick* Frontiſpiece, with a ſemicircular-headed Door, whoſe Impoſt and Architrave may be as Figure B, or Figure G. Figure C is a good Entablature, with a ſwelling Freeze, to be uſed over Windows, or Doors, as Occaſion

Occafion requires. Figure F is another Frontifpiece for a Door or Window, crowned with a circular Pediment. This and the other Frontifpiece are given by *Scamozzi*, as Examples for Practice. Figure D reprefents the under View, or *Sofito*, of the Voluta's and Abacus of the Capital, as alfo the Pofitions of the Volutes, in their Diagonal Situations, whereby the Capital has the fame Appearance in Profile, as in Front.

Plate CXXV. Ionick *Intercolumnations, by* V. SCAMOZZI.

THE two Examples next the Right-hand are Intercolumnations for *Temples* or *Colonades*, viz the upper 1, without Pedeftals, for *Temples*; the other below without Pedeftals, for a continued *Colonade*. The two other Figures, on the Left, are Intercolumnations for Arcades, wherein the upper 1 is without Pedeftals, and the lower one with Pedeftals. Their feveral Diftances are denoted by Modules and Minutes, or Parts.

Plates CXXVI. CXXVII. *The* Ionick *Order, by* M. J. BAROZZIO *of* Vignola.

THE Module, by which the Members of this Order are meafured, is the Semidiameter of the Column, divided into 18 parts, of which every Member contains as the Figures to each exprefs.

AS to the Compofition of this Order in general, no material Fault could have been found, had not the Pedeftal been made fo very high in its Die, and that monftrous *Torus* introduced in the Bafe to the Column. The Capital is really as good, as any of the ancient Capitals, and the Entablature is a grand Compofition. The Manner of defcribing the Volute has been already taught in Method I. Plate Z, after Plate CV. Figure III. is a View of a Side of the Capital, where the Pillow fills up all the Space between the Lifts of the fore and back Volutes. Fig. IV. is a View of the Members of the Capital, with their Meafures divefted of the Volutes. Fig. IX. is the Sofito, or View of the under Part of the Capital, which projects beyond the Aftragal of the Column. The Height of the Pedeftal is 6 mod. of which its Bafe is $\frac{1}{2}$ mod. its Die 5 mod. and Cornice $\frac{1}{2}$ mod. *Vide* Fig. II. and VII. The Height of the Column is 16 mod. $\frac{5}{6}$, of which its Bafe is 1 mod. its Capital 12 parts, and Aftragal 3 parts. The Height of its Entablature is 4 mod. $\frac{1}{2}$, of which the Architrave is 1 mod. $\frac{1}{4}$, the Freeze 1 mod. $\frac{1}{2}$, and the Cornice 1 mod. $\frac{3}{4}$. The Shaft is diminifhed $\frac{1}{6}$ part of its Diameter at the Bafe.

		Mod.
The Height of the	Pedeftal and Column	22 $\frac{5}{6}$
	Column and Entablature	21 $\frac{2}{6}$
	Pedeftal, Column and Entablature	27 $\frac{2}{6}$

Plate CXXVIII. *An* Ionick *Arcade without Pedeftals, by* M. J. BAROZZIO *of* Vignola.

THE Diftance of the Columns in this Arcade would have been better, had he placed them 1 mod. more diftant, to have admitted of the Pilafters being made 1 mod. in their Diameter, inftead of half a Module, which is half a Module too narrow, and which, being compared with the Diameter of the Columns, have a very bad Effect; the Architrave of the Arch would have been alfo of double the Breadth, and confequently more noble. Therefore I advife, whofoever follow this Mafter, to make the Intercolumnation 1 mod. greater than here reprefented, which give to the Pilafters equally, and encreafe the Architrave the fame alfo.

Plate

Plate CXXIX. *An* Ionick *Arcade with Pedestals, by* M. J. BAROZZIO *of* Vignola.

THE Pilasters under the Imposts of this Arcade being equal to 1 mod. or Semidiameter of the Column, have a much more noble Aspect, than those of the last Plate; and may be taken as a good Example for the Practice of the young Student.

Plate CXXX. Ionick *Intercolumnations for a Colonade, by* M. J. BAROZZIO *of* Vignola.

THE three upper Columns represent the Intercolmnation for Columns in a *Portico*, or *Colonade*, whose Distances are denoted in Modules and Parts. In the lower Part of the Plate, on the left Hand, are the Intercolumnations for *Colonades*, or *Portico's*, by *Sebastian le Clerc*; and on the Right are two Kinds of Arcades, the one with single Columns, the other with Columns in Pairs, by the same Master, whose several Measures are signified by the Module or Diameter of the Column, divided into 60 Parts or Minutes, as in his preceding Orders.

I must here advertise, that these Intercolumnations of *Le Clerc* are brought on before their Place, which was occasioned by that Part of the Plate being void, and thought convenient to be filled therewith, and more especially, as that the *Ionick* Order of this Master is represented in Plates CXXXVIII. CXXXIX. CXL. CXLI. CXLII. which are very near unto it.

Plate CXXXI. *The* Ionick Order, *by* S. SERLIO.

THIS Master gives us two Examples, as Figures A and B, the one having a flat Freeze, with Dentils only; the other with a swelling Freeze, with both *Dentils* and *Modillions*; which last, as *Vitruvius* observes, is absurd, as that Dentils are peculiar to the *Ionick*, and Modillions to the *Corinthian*. As to the Entablature with *Dentils* only, which is expressed on the left Hand at large, there is not any Thing in it that is very good, the upper *Cima recta* being much too large for the *Cima reversa* under it, as indeed are the Dentils to the *Cima recta* under that: And, as the Tenia of the Architrave hath a considerable Projection, the Height of the Freeze (which in itself, I think, is much too low) is made to look very low. The Capital is truly ancient, as its Base is truly ugly, with its great Torus and small Astragals. The Height of the entire Order, divided into 9 equal parts, the lower 2 is the Height of the Pedestal; the remaining 7 parts divided into 5 parts, the upper 1 is the Height of the Entablature, the lower 4 the Height of the Column; the Height of the Column divided into 8 equal parts, take 1 for the Diameter of the Column; the Height of the Pedestal divided into 8 equal Parts, (as on the left Hand) give one to the Cornice, 1 to the Base, and 6 to the Die. The Members of the Base and Capital of the Column being determined by Modules and Minutes, I refer you to them for the same.

Plate CXXXII. *The Base, Capital, and Entablature of the* Ionick Order *at large, determined by equal Parts, by* S. SERLIO.

THE Base, Capital, and Entablature of this Master, represented in the last Plate, having their Parts determined by Modules and Minutes, according to Mr *Evelyn*, I shall here explain *Serlio*'s own Method of determining their Heights and Projectures by equal Parts. The Base, whose Height is equal to the Semidiameter of the Column, is divided into 3 parts, the lower 1 of which,

as

as *cb*, is the Height of the Plinth; the other 2 parts divided into 3 parts, the upper 1 *de* is the Height of the Torus, and lower 2, the two Scotia's and Aftragals. Draw *kg*, which is the Height of the upper Scotia and upper Aftragal, divide it into 4, the lower 1 is the Height of the Aftragal, and the upper 3 being divided into 4, give the upper 1 to the Fillet under the *Torus*, and the reft to the Scotia. Draw *r s*, and being divided into 4, give the upper 1 to the Aftragal, and the lower 3 to the Scotia, and that will complete the Bafe. The Capital being defcribed in the next Plate, I come next to the Entablature, whofe Height is equal to 1 mod. or Diameter, and 32 min. of which the Architrave is 30 min. the Freeze 22 $\frac{1}{2}$, and the Cornice 30 $\frac{1}{2}$. The Tenia of the Architrave is a 7th part of the Whole; the remaining 6 divided into 12, give 5 to the upper Fafcia, 4 to the middle, and 3 to the lower. Make the Cima *e d* equal to a 7th of the Freeze, the Height of the Dentils equal to the middle Fafcia of the Architrave, its *Cima reverfa* to a 5th of itfelf; the Height of the *Corona*, and the *Cima reverfa* over it, are alfo equal to the middle Fafcia, and which being divided into 3, the upper 1 is the Height of the *Cima reverfa*; the remaining Height, which is alfo equal to the Height of the middle Fafcia, and $\frac{1}{8}$ part thereof, is the Height of the great *Cima recta* and its Regula. The Projection of the *Cima reverfa* over the Freeze is equal to its Height, as alfo is the Projection of the Dentils before the Fillet of the *Cima*, equal to the Height. Divide the Projection of the Dentil before the Fillet into 6 equal parts, then take the outer 3 for the Breadth of a Dentil, and the next 2 for an Interval between; by which fet out all others. The Projection of the *Corona* is equal to the Height of the Freeze, and the two *Cima's* over it to their own Heights. The Diminution of the Column (which is of 8 diam. in Height) is a 6th of its Diameter at the Bafe.

			Diam.	Min.
The Height of the	Pedeftal	is	2	5 $\frac{1}{7}$
	Pedeftal and Column		10	5 $\frac{1}{7}$
	Column and Entablature		9	32
	Pedeftal, Column and Entablature		11	37 $\frac{1}{7}$

Plate CXXXIII. *The* Ionick *Capital, by* S. SERLIO.

THE Volute of this Capital is defcribed by 6 Centers, as reprefented in the Eye; the Height of the Eye is equal to the Height of the Aftragal, and the *Cathetus* is drawn (to interfect it) from the Upright of the Column. The Height of the Capital is equal to $\frac{1}{3}$ of the Diameter, or 20 min. which divided into 11 parts, the upper 1 is the *Regula* or upper Fillet, the next 2 the *Cima*, the next 4 the Volute, the next 4 the Ovolo. The Aftragal and its Fillet is equal to 2 parts. The Height of the Lift of the Volute is a 5th of its Height.

Plate CXXXIV. *An* Ionick *Portico, and a Colonade, by* S. SERLIO.

THE upper Figure reprefents a Portico to a Temple, and is very good; the lower is an arcaded Colonade, whofe Intercolumnation is, I think, rather too great for this Order, but yet has a very grand Afpect. Thefe are given as Examples for Practice.

Plate CXXXV. CXXXVI. *Three* Ionick *Frontifpieces, by* S. SERLIO.

FIG. A is a rufticated Frontifpiece, which would have made a noble Figure, had not the natural courfe of the Architrave and Freeze been broken by the Key-ftones of the Arch over the Door, and had another Bafe to the Columns, of fewer and larger Members, been introduced, inftead of that monftrous

Baſe, which he has copied from *Vitruvius*, and which the Largeneſs of the Ruſticks cauſe to appear much worſe, than were the Columns not ruſticated. Figure B is a good Frontiſpiece for a Window, as Fig. C would have been for a Door, had a better Baſe to the Columns been introduced.

Plate CXXXVII. *The* Ionick *on the* Dorick Order, *as in the Theatre of* MARCELLUS *at* Rome.

THIS Plate repreſents the Manner of placing one Order over another, wherein the Intercolumnations of both Orders are regulated by the Intercolumnation proper to the lower Order; becauſe the central Lines of the Columns in the upper Order muſt ſtand perpendicular over the central Lines of the lower Order: And as the Diameter of the Columns in the upper Order muſt be made, at their Baſes, equal to the Diameters of the lower Columns at their Aſtragals, whereby the Law of placing Solid over Solid is maintained; therefore the Arcades above will either have their Pilaſters under their Arches, or the Diameters of the Arches, of greater Diameter than thoſe under them in the lower Order, excepting when Pilaſters without Diminution are uſed inſtead of Columns. But of this much more will be demonſtrated in the following Plates.

Plate CXXXVIII. *The* Ionick Order, *by* S. LE CLERC.

THIS Plate repreſents the entire Order, the Pedeſtal entire with the Baſe to the Column, (which is *Attick*) the Corince and Baſe to the Pedeſtal at large, and the Capital with its Volute, which is deſcribed according to Method II. in Plate Z, following Plate CV. The Module, by which the Members are determined, is the Semidiameter of the Column divided into 30 min.

Plate CXXXIX. Ionick *Capitals and Entablatures, by* S. LE CLERC.

THAT we may be the better able how to judge of the different Effects of the antient and modern Capitals, this Maſter has here placed them together, at Figures M and N with different Entablatures; Fig. G is yet a more modern Capital than that to the Entablature N, and which, being elevated ſomething more than the other, above the Aſtragal of the Column, has not a bad Effect, but, I think, is a Grace to the Capital, and gives it a more noble Aſpect. Fig. H is the Sofito of the Ovolo, and Aſtragal of the under part of the Capital. Figures K and L are Sofito's of the Dentils, exhibiting two different Ways to return them at a Right Angle. Fig. O and P repreſent the Key-ſtone of the *Ionick* Arch, that of P in Front, and that of O in Profile. Fig. ACDBEF represents the Manner of dividing the Flutes and Fillets in the Shaft of the Column, wherein the Radius AC is divided into 7 equal parts, and the Fillet CD is made equal to 4 of thoſe parts.

Plate CXL. Ionick *Capitals, by* S. LE CLERC.

THIS Plate exhibits the various parts of the ancient and modern Capitals, in different Views, whoſe Members are in general determined by Modules and Minutes.

Plate CXLI. Ionick *Entablatures and Impoſts, by* S. LE CLERC.

THIS Plate repreſents four Varieties of Entablatures, and ſix Varieties of Impoſts and Architraves to Arches, all whoſe Members are determined by Modules and Minutes, as in the preceding.

Plate

Plate CXLII. Ionick *Arcades, with the* Ionick *on the* Dorick Order, *by* S. LE CLERC.

THE two uppermoſt Figures are two fine Examples of Arcades, as indeed are the two Examples below, for Galleries, where that on the Left is arcaded with Baluſters between the upper Columns, and that on the Right a Colonade with a continued Pedeſtal. In both theſe Examples you ſee the central Lines of both Orders make but one Right Line, as before obſerved.

Plate CXLIII. Ionick *Arcades, by* S. LE CLERC.

THIS Plate repreſents 4 Figures of Arcades, as alſo a Plan of the Sofito of the Cornice, wherein is exhibited the Manner of its Return as well at an internal, as at an external Angle. The Intercolumnations are here regulated as well by the Number of Dentils, between the central Lines of each pair of Columns, as by the Modules and Minutes affixed thereto.

Plates CXLIV. CXLV. *The* Ionick Order, *by* CATANEO, D. BARBARO, VIOLA, L. B. ALBERTI, P. DE LORME, *and* J. BULLANT, according to *Mr.* EVELYN.

AS a little Inſpection will make plain the Difference between theſe Maſters, who in general affect the monſtrous Baſe of *Vitruvius*, I need only add, that the Meaſure, by which all their Parts are determined, is the Diameter divided into 60 min. and that their Projections are all accounted from their central Lines.

Plate L K, to follow Plate CXXVII. *The* Ionick Order, *by* PALLADIO, SCAMOZZI, *and* VIGNOLA, *according to Mr.* EVELYN.

THIS Plate having by Miſtake eſcaped its proper place, I introduce it here on account of the Members being determined by Modules and Minutes, and the Projections ſet off from the central Line, according to Mr. *Evelyn*, as the ſix preceding. The Baſe of *Vignola*'s is the ſame with that of *Vitruvius*, but *Palladio* has taken the *Attick* Baſe, and added an Aſtragal above the upper Torus. All the foregoing Maſters uſed the ancient Capital, but *Scamozzi* invented a new one, whoſe Volutes rowl out at the Angles, and make all the four Sides of the Capital appear alike; this, being better approved of by ſucceeding Maſters, is called the modern Capital, and is more in Uſe than the ancient. The Baſe of *Scamozzi* has the ſame Members as *Palladio*'s, but different Proportions, as expreſſed by the Figures.

Plate CXLVI. *The* Ionick Order, *by* C. PERAULT.

HAD this Maſter been ſo happy, as to have omitted the Baſe of *Vitruvius* to the Column, and introduced ſome other of fewer and more proportionate Members, than thoſe poor trifling Aſtragals, and monſtrous Torus, the Compoſition of this entire Order would have been very good, and more eſpecially, had he made but two Faſcia's, inſtead of three to the Architrave. The Freeze and Cornice are very noble, as the Architrave would be, were it divided as aforeſaid.

To proportion this Order to a given Height.

(1) *If for the Order entire,* divide the given Height into 40 equal parts, give the lower 8 to the Height of the Pedeſtal, the upper 6 to the Height of the

the Entablature, and the remaining 26 to the Height of the Column. The Diameter of the Column is equal to 3 of thofe 40 par. (2) *If for the Column and Entablature only*, divide the given Height into 32 parts, give the upper 6 to the Entablature, and lower 26 to the Column. (3) *If for the Pedeftal and Column only*, divide the given Height into 34 parts, give the lower 8 to the Pedeftal, and the upper 26 to the Column. (4) *The Height of the Pedeftal being given, to divide it into its Bafe, Die, and Cornice*, divide the given Height into 8 parts, give the lower 2 to the Bafe, the upper 1 to the Cornice, and the remaining 5 to the Die. *To divide the Mouldings of the Bafe to the Pedeftal*, divide the given Height into 3 parts, give the lower 2 to the Height of the Plinth, and the upper 1 to the Height of the Mouldings, which fub-divide into 8, and give the upper 2 to the Cavetto, the next 1 to the Fillet, the next 4 to the *Cima recta*, and the lower 1 to the Fillet. *To divide the Height of the Cornice into its Mouldings*, divide the given Height into 10, as on the Left, give the upper 1 to the *Regula*, the next 2 to the *Cima reverfa*, the next 4 to the *Plat-band*, the next 1 to the *Fillet*, and the lower 2 to the *Cavetto*. *The Projection of the Cornice to the Pedeftal* is thus found, divide the Diameter of the Column into 15 equal parts, give 3 of thofe parts to the Projection of the Plinth to the Bafe of the Column, (under which ftands the Upright of the Die) and 4 to the Projection of the Cornice beyond the Die; and if, from every of thofe 4 divifional parts, as 1, 2, 3, 4, Right Lines be drawn at Right Angles to the Members, they will determine the Projections of the feveral Members, as well in the Bafe as in the Cornice. (5) *The Height of the Bafe to the Column being given*, divide it into 3 equal parts, give the lower one to the *Plinth*, the other 2 being divided into 7, give the upper 3 to the *Torus*, the next 2 to the upper *Scotia* and upper *Aftragal*, the Remainder to the lower *Aftragal* and lower *Scotia*, which fub-divide as in the Figure. *The Height of the Capital* is 1 third part of the Column's Diameter at its Bafe, *viz.* from the Top of the Aftragal to the Top of the *Abacus*, which being divided into 11 parts, give the upper 3 to the *Abacus*, the next 4 to the *Volute*, the next 4 to the *Ovolo*. The fame parts being continued, make the Aftragal with its Fillet equal to 3, and the lower part of the Volute equal to 5 more. The Volute is defcribed according to Meth. II. Pl. Z, after Pl. CV. (6) *To divide the Height of the Entablature into its Architrave, Freeze and Cornice*, divide the Height into 20 parts, give 6 to the *Architrave*, as many to the *Freeze*, and the upper 8 to the *Cornice*. *To divide the Architrave into its Tenia and Fafcia's*, divide the given Height into 5, and, giving the upper 1 to the *Tenia*, divide the lower 4 into 12 parts, give 3 to the lower *Fafcia*, 4 to the middle, and 5 to the upper. *To divide the Cornice into its Members*, divide its Height into 8 parts, give the lower 1 to the *Cima reverfa*, the next 2 to the *Dentils* and their *Aftragal*, (which fub-divide into 8) the next 1 to the *Ovolo*, the next 3 to the *Corona* with the *Cima reverfa*, and the upper 2 to the great *Cima recta* and its *Regula*, whofe Projection is equal to the Height of the *Cornice*. Divide the Projection into 12 parts, and determine the Projection of the Dentils from the 2d and 3d, the Ovolo from the 5th, *&c.*

Plate CXLVII. *The* Ionick Order *entire, by* J. MAU-CLERC.

HERE are two Examples, the one with a Pedeftal, the other without; fo likewife the one with a fwelling Freeze, the other with a plain Freeze. The Height of the entire Order being divided into 14 parts, the lower 3 is the Height of the Pedeftal, and the remaining 11 parts being divided into 10, the upper 2 is the Height of the Entablature, and the lower 8 the Height of the Column; the Diameter of the Column is one 8th of its Height. The other Example on the left Hand, without a Pedeftal, the given Height being divided into 7, the Height of the Entablature is equal to 1 part and one 6th; the remaining Height divided into 8 parts, take 1 for the Diameter of the Column.

Plate

Plate CXLVIII. *The* Ionick *Base, Capital, and Entablature at large, by* J. MAU-CLERC.

THIS monstrous Base in Height is equal to the Semidiameter of the Column, and its parts are divided and sub-divided, first into 3, then into 7, and lastly into 8. The Capital is of greater Height than generally practised, being equal to 3 quarters of the Column's Diameter, whereas the common Height is but 1 third part of the Diameter. This Height being divided into 13 parts and half, or rather into 27 parts, give to each Member as in the Plate is exhibited. *The Height of the Entablature being given,* make the Height of the Architrave, and of the Freeze, each equal to the Semidiameter of the Column, and the Remainder is the Height of the Freeze, which subdivide into their several Members, as on the left Hand is exhibited. The Diminution of the Shaft is $\frac{1}{6}$.

Plate CXLIX. *The Base and Cornice of the* Ionick *Pedestal, together with the Base and Capital of the Column, and two Examples of Entablatures, by* J. MAU-CLERC.

As the following Plate doth contain the Pedestal at large, I need say nothing here thereof. The Base to this Column is of the same kind as the preceding, but the Proportion of its Members are not the same, nor are the Divisions the same, that being by Divisions of 3, 7, and 8, and this by twice 3, and once 12. The Capital of this is of the common Height, *viz.* equal to one 3d of the Diameter, divided into 5 parts and half, or rather into 11 parts. *The Height of the Entablature* being divided into 10 parts, give 3 to the Architrave, as many to the Freeze, and the upper 4 to the Cornice; then subdivide the Members as the Divisions exhibit.

Plate CL. *The* Ionick *Pedestal, by* J. MAU-CLERC.

THE Height being given, divide it into 8 equal parts, give the lower 1 to the *Base,* and the upper 1 to the *Cornice*; then subdivide the Height of the Base and Cornice into their respective Members, as the Divisions exhibit.

Plate CLI. *The Base to the* Ionick *Column, its Volute, and Impost, by* J. MAU-CLERC.

THE Design of this Base being shewn here at large, is to shew the Manner of this Master's enriching its Members, which indeed is very extravagant, and are to be only used in Altar-pieces, or other inside Works. The Volute E A is described according to Method II. Plate Z, after Plate CV. Figure F is the Impost enriched also.

Plate CLII. *The Base and Capital of the* Ionick *Column enriched by* J. MAU-CLERC.

As I observed the preceding Base was too much enriched, I have therefore given here another Example of this Master's something less crowdedwith Carvings; and though perhaps neither of them may have been exactly copied by any, yet they are very great Helps to Invention, teaching the proper Ornaments to those Members, which are to be used at Discretion.

Plates CLIII. CLIV. CLV. CLVI. *The* Ionick *Capital and Entablatures at large, by* J. MAU-CLERC.

THESE Plates repreſent the various Ornaments, with which this Maſter embelliſhed the Members of his Capital, and of his three Varieties of Entablatures, which are of a very grand and magnificent Taſte. The Capital in Plate CLIII. is very noble and rich, and its extraordinary Height is a very great Addition to its Beauty, and therefore worthy of Imitation. The Entablature A, Plate CLIV. is alſo very grand, and its Enrichments are truly elegant, provided that the Freeze be not enriched, according to the ſmall Deſign placed againſt it, which would crowd the Whole.

PLATE CLV. exhibits a very grand Sofito to the Corona of the Cornice, and not a bad Entablature, altho' the great *Cymatium* on the Cornice is wanting, and which, I do really think, was the firſt Method of finiſhing of Cornices by the Ancients; for, if we rightly conſider the *Cima reverſa* on the *Corona*, it is as a Band, or Finiſhing to it; and as the *Corona* is ſo called, which ſignifies the *Crown*, 'tis very reaſonable to believe, that it was the uppermoſt part of the Cornice, as the Crown of the Head is the uppermoſt part of the Body: Beſides, when Pediments are uſed, the Corona is diſengaged from the *Cima recta*, that being a part of the Pediment, and not of the continued Cornice. But however, be that Conjecture of mine as it will, certain it is, that the Ornaments of theſe Members are of very great Help to Invention.

PLATE CLVI. is an Entablature of very great Majeſty, and fine Deſign, to be uſed in the Inſides of *Halls, Saloons, State-rooms*, &c.

Plate CLVII. CLVIII. *The* Ionick *Order, by* I. JONES, *in the Royal Chapel at* Whitehall.

THE *Banquetting-houſe at Whitehall*, now made one of his Majeſty's Royal Chapels, was built by this Maſter in the Reign of *James* I. Its Height within ſide, as well as without ſide, is divided into 2 Heights of Orders, that is to ſay, the lower Order *Ionick*, and the upper Order *Compoſite*. The *Ionick* is here repreſented very accurately in Plate CLVII. and its Intercolumnation in Plate CLVIII. wherein the Heights and Projections of every Member are expreſſed by Feet, Inches and parts.

Plates CLIX. CLX. *The* Ionick *Order, by* I. JONES, *in the Royal Chapel at* Somerſet-houſe.

AS I have already exhibited in Plates XCII. and XCIII. the *Dorick* Order of the Skreen, in the Royal Chapel at *Somerſet-houſe*, I ſhall here repreſent the *Ionick* Order in the Altar-piece, and the Altar-piece alſo. Plate CLIX. contains the Profile of the Order, and Plate CLX. the Altar-piece; wherein the Members of the Order, and its Intercolumnation, are determined, and meaſured by Feet, Inches and parts.

Plates CLXI. CLXII. *The* Ionick *Order, by Sir* C. WREN

THIS Maſter of immortal Memory has given us a fine Example of this *Ionick* Order in the Church of St. *Magnes*, at the Foot of *London-bridge*, whoſe Profile is repreſented in Plate CLXI. and Intercolumnation in Plate CLXII. wherein the Members of the Order, &c. are meaſured by Feet, Inches and parts, as the Figures affixed thereto expreſs.

Plate CLXIII. *The* Ionick *Order by Mr.* GIBBS.

THIS Maſter has very judiciouſly excluded the monſtrous Baſe of *Vitruvius*, which almoſt every of the foregoing Maſters have followed, and has divided his Architrave into two Faſcia's only, which is more agreeable to this Order, than three, of which I have already taken notice. The *Attick* Baſe here introduced I cannot think to be ſo proper to this Order, as it is to the *Corinthian*, and therefore I would recommend, in its ſtead, a Baſe conſiſting of a Plinth, a Scotia, and a Torus, with their proper Fillets for Separation. The Height of the Plinth to be one third of the Height of the Baſe, that is, of the Semidiameter; the Height of the *Scotia*, and of the Torus to be each the ſame, abating the two Fillets, one out of each, whoſe Height muſt be one ſixth part of their Height. This Baſe would I ſubſtitute for the *Ionick* Baſe, and employ the *Attick* Baſe to the *Corinthian* Order only. *To proportion this Order entire to a given Height*, divide the Height into 5 equal parts, and give the lower 1 to the Height of the Pedeſtal; and the other 4 parts being divided into 5 parts, give the upper 1 to the Height of the Entablature, and the lower 4 to the Height of the Column; which being divided into 9 equal parts, take 1 for the Diameter of the Column, whoſe Baſe hath its Height equal to the Semidiameter of the Column, and Capital to one third of its Diameter. *To divide the Height of the Pedeſtal into its Baſe, Die and Cornice*, divide the given Height into 4 equal parts, give half the upper 1 to the Height of the Cornice, the lower 1 and one third of the next to the Height of the Baſe, and the Remainder to the Die. *To divide the Height of the Baſe into its Mouldings*, (1) The Height of the Plinth is one fourth part of the whole Height of the Pedeſtal, and the Remainder is the Height of its Mouldings. (2) *To divide the Height of the Mouldings*, as Fig. H, Plate CLXIX. divide the Height into 2 parts, and each part into 4; give the lower *Fillet* ſitting on the Plinth 1, the *Cima recta* 4, the Aſtragal 1, its Fillet half of one, and the upper 1 and half to the Cavetto. *To divide the Cornice into its Members*, divide the Height into 3, and each into 4; give the upper 1 to the *Regula*, 2 to the *Cima reverſa*, 3 to the Plat-band, and as many to the Ovolo, the next 1 to the Aſtragal, and the Remainder to the Fillet and Cavetto. *To divide the Baſe of the Column into its Mouldings*, Fig. DACFEB, Plate CLXIX. divide the Height into 3, the lower 1 is the Height of the Plinth; then the remaining 2 being divided into 9, give the lowermoſt 3 to the Height of the lower *Torus*, the upper 2 ½ to the upper *Torus*, and the others to the Fillets and *Scotia*.

THE Projection of the Baſe to the Pedeſtal is equal to the Height of its Mouldings on the Plinth, and the Projection of the Cornice is the ſame. *To determine the Projections of their Members*, divide the whole Projection into 8 parts, as between the Figures G, H, and from thence determine each Member, as there expreſſed. The Projection of the Die of the Pedeſtal is equal to that of the Plinth to the Baſe of the Column, which is equal to two thirds of the Diameter of the Column, whoſe Height is 9 diam. and Diminution one ſixth part of its Diameter.

Plate CLXIV. *The* Ionick *Capital, by Mr.* GIBBS.

THIS Plate exhibits three Figures, as *firſt*, the upper one, which repreſents a direct View of the Capital; *ſecondly*, the middle one, which is a Plan, repreſenting 1 quarter part of a Column on the left Side, and a quarter part of a Pilaſter, or ſquare Column, on the right Side. Between theſe 2 Figures is placed a Scale of 1 diam. of the Column at its Baſe, which hath 1 half part divided into 6 parts; and which, being continued both ways equal to 3 parts on each Side, determines the Projection of the Capital. *To deſcribe the Capital*,

tal, draw its central Line, and another, at Right Angles (*cross-wise*, as Mr. *Gibbs*, in his low Language, terms it) for the upper part of its Abacus. The Altitude of the Capital from A to B, the lower part of the Volute, is equal to the Semidiameter of the Column, which divide into 3 parts, and give the upper 1 to the Abacus, which divide into 2, and the upper 1 into 4, of which give the upper 3 to the *Ovolo*, and lower 1 to the *Fillet*. Divide the remaining part C B into 8 parts, give the upper 2 to the Fascia of the Abacus, the next 2 to the Ovolo, the next 1 to the Astragal, and the next ½ to its Fillet. The Volute, being the next Work, is described at large in Plate CLXV. to which I refer you.

HAVING thus done with the Capital in its direct View, I shall now proceed to shew *how to describe the Plan of a Capital.* (1) As the Shaft of the Column at its Astragal is diminished one sixth part of the Diameter at its Base, therefore (if your Column be circular) describe a Circle, whose Diameter is equal to ⅚ of the Diameter at the Base; or, if a Pilaster, describe a geometrical Square of the same Diameter. (2) Take the Projections of the *Fillet*, the *Astragal*, and the *Ovolo*, and their respective Distances from the Upright of the Column; set off from the Circle, or Square, representing the Plan of the Head of the Shaft; and, through those Points, describe Circles, if to a circular Column, or Squares, if to a square Column, and they will represent the Plans of those Members.

THE Number of Flutes are 24, which describe as follows: Divide the Circumference of the Shaft into 24 equal parts, which will be the Centers of each Flute; this done, divide each ½ part into 4 parts, and on the Centers aforesaid, with the Radius of 3 of those 4 parts, describe the semicircular Flutes, which will leave 24 Fillets between them, whose Breadth will be equal to ⅓ of a Flute. The Eggs and Darts in the Ovolo are of the same Number, and should answer the same Divisions. The Flutes of square Columns, or Pilasters, are the same as in round Columns.

P. *Pray explain this; for I never could be informed by any, why the Side of a Pilaster must have 7 Flutes, and no more. Mr.* Gibbs, *in his* New Rules of Drawing, *Fol.* 15, *says, The Flutes of Pilasters, or square Columns, must be the same as in round Columns, which will make 7 in Number, divided from the middle, with a Remainder of ⅓ at the Corner: But really, Sir, I can't understand his Language, his Terms being very uncommon: He says they must be so; but why they must be so, and why they are so, I must desire you to demonstrate to me; and whether he doth not mean the* Angle, *when he says, the* Corner *of each Pilaster?*

M. I WILL make all these easy to your Understanding, and his Terms also; you must not critically read this Master, nor be angry if his Terms be a little aukward, as indeed they are in many Places of his *New Rules of Drawing*, as he only can call them; therefore, when he says, you must *draw a Line for the middle of the Capital, and another cross-wise for the upper Part of it*, as in Fol 14, which is not to be easily understood, because one Line may be drawn *cross-wise* to another Line, as well at Oblique, as at Right Angles, yet you are always to understand, that, when he says *cross-wise*, he means (tho' he had not Sense enough to say) at Right Angles: So likewise, when he is speaking of a Corner, he means an Angle, and an Astragal, when he is speaking of a Bead.

NOW to the Purpose, as the Breadth of every Fillet is equal to one third of a Flute, therefore we may account every Flute with its Fillet as 4 parts; and as there are 24 Flutes, and as many Fillets, therefore they together make 96 parts, in the whole Circumference of a circular Column, which are the Number of parts, into which we must conceive the Circumference of every *Jonick* Shaft to be divided. This being understood, we must in the next Place find, how many of such parts are contained in the Diameter; which may be found near enough for our Purpose by this

A N A-

ANALOGY.

As 22 is to 7, so is 96, the parts into which the Circumference is suppoſed to be divided, to a fourth Number, which is the Number of parts in the Diameter required.

EXAMPLE.

$$22 : 7 :: 96 : 30\tfrac{6}{11}$$

$$\begin{array}{l} 7 \\ \hline 22)672(30 \\ 66 \\ \hline \end{array}$$

12 remains, equal to $\frac{6}{11}$

THIS fourth Number, $30\frac{6}{11}$, being the Number of parts in the Diameter, we muſt now conceive this Circle to be circumſcribed by a geometrical Square, whoſe Diameter is equal to that of the Circle, and its Side to the Diameter; and as one Side of this Square contains but $30\frac{6}{11}$ parts, and as 1 Flute, with its Fillet, contains but 4 parts, 'tis plain; that if $30\frac{6}{11}$ be divided by 4, the Quotient is 7, and $2\frac{6}{11}$ remains. Now, as 7 Flutes muſt be included between 8 Fillets, therefore take 1 of the parts from the 2 parts and $\frac{6}{11}$ remaining, and give it to the 7 Flutes and 7 Fillets, and then there is but 1 part and $\frac{6}{11}$ remains, which is to be divided into 2 parts, and each half placed at the Extreams, or Angles, to be worked into 2 three-quarter perpendicular Cylinders, commonly called Beads: And thus have I demonſtrated to you, why a Pilaſter muſt be divided into 7 Flutes and 8 Fillets, as you required. Now I'll return to finiſh the Plan of the Capital, whoſe central Line being the ſame with the central Line of the Profile, compleat a geometrical Square, ſo that its Sides be ſo far diſtant from the Center of the Plan, as the Projection of the Abacus is from the central Line of the Capital. Divide each Side of the Square into 12 parts, and the 10 inward Parts will be the Extent of the Arch of the Abacus, whoſe Center D is at an equilateral Diſtance. Draw G G parallel to F F, ſo that the Diagonal Line of the Capital may biſect G G, and make G G equal to half F F, and drawing the Lines F G, F G, biſect them to find the Diviſion of the 2 Members of the Abacus. The greateſt Projection of the Volute L, Fig. 3, (*falls plumb*, ſaith this Maſter, with the lower part of the Abacus, that is,) having the ſame Projection, as the lower part of the Abacus, is therefore perpendicularly under it.

Plate CLXV. *Mr.* GIBBS's *Rule for drawing the ſpiral Lines of the Scotch Volute to the* Ionick *Capital.*

(1) DIVIDE the given Height A B into 8 parts, and make the Breadth C 3 A equal to 7 of thoſe parts. The Height of the 4th part, in the Line B A, is the Height of the Eye, which divide into 2 parts, with the Line *m* 12 continued out at pleaſure. (2) From 4, the 3d part in the Line C A, erect a Perpendicular, which will cut the Line *m* 12 in the Center of the Eye, on which deſcribe a Circle, making its Diameter equal to the Height 3 4; wherein inſcribe a Square, whoſe Diagonals ſhall be in the two Lines aforeſaid, whoſe Interſection is the Center of the Eye. Draw the Diameters of the Square through its Center; and divide each Semidiameter into 3 parts, as are expreſſed more at large in the lower Figure, where the Centers are marked 1, 2, 3, *&c.* From theſe Centers draw Lines parallel to the Diagonals of the Square extended on each Side; then, on the Center 1, with the Radius 1 1, which this Maſter calls *Length*, according to the *Scotch* Mode of

 Speech,

Speech, defcribe the Arch 1 2; alfo on the Center 2, with the Radius 2 2, defcribe the Arch 2 3; and on the Center 3, with the Radius 3 3, defcribe the Arch 3 4. Proceed in like Manner at the remaining Centers, which will compleat the fpiral Line at the upper Point of the Eye. The inner fpiral Line is parallel to the outer from 1 to 3, and therefore is defcribed on the fame Centers; the other Centers are expreffed by the refpective Letters, as *b, c, d, f, g, h,* &c. The Breadth of this Fillet is equal to one 16th part of the whole Height of the Volute. Thus have I given you this Rule for to defcribe the *Scotch* Volute, which hath a very difagreeable and clumfy Diminution, not to be practifed by any.

Plate CLXVI. *The* Ionick *Entablature by Mr.* GIBBS.

THE Altitude of the Entablature being found, divide it into 10 parts, give the lower 3 to the Architrave, the next 3 to the Freeze, and the upper 4 to the Cornice, whofe Projection is equal to its Height, and divided into 4 parts, from whence the Projection of the Corona, *&c.* is determined. The particular Members of the Architrave aud Cornice are defcribed more at large in the following Plates.

Plates CLXVII. CLXVIII. CLXIX. Ionick *Cornices, Arcades and Impofts, by Mr.* GIBBS.

THE Figure AIB, Plate CLXIX. reprefents the Architrave at large, divided into 3 parts, of which the lower 1 is the Height of the lower Fafcia, and its *Cima reverfa* is a fourth part thereof. The Tenia is three fourths of the upper 1 divided into 3; the upper 1 is the Fillet. The Projection of the Tenia is equal to its Height; which Projection being divided into 3, the firft 1 gives the Projection of the upper Fafcia.

THE lower Figure in Plate CLXVII. reprefents an *Ionick* Modillion Cornice, whofe Height is divided into 4 principal parts, and thofe fubdivided again for the Divifion of the fmaller Members. It is to be obferved, that, when this Cornice is ufed with Columns, it muft have its Modillions $\frac{1}{4}$ of the Diameter of the Column, and the Interval between them $\frac{1}{3}$, or $\frac{1}{3}$ of the Diameter, that is, the Diftance from the central Line of 1 Modillion to the other muft be equal to the Semidiameter of the Column; and that being divided into 6, give the outer ones to half of each Modillion, and the Interval will be the middle 4. The Breadth of each Modillion in Front muft be made equal to 2 of thofe 6 parts, and the Length of a Modillion in Profile muft be equal to 3, or 1 fourth part of the Column's Diameter. The prick'd Line A B is the central Line of the Column, over which the 2d Modillion muft ftand. The Line C D fhews the diminifhed part of the Column, which toucheth the Side of a Modillion. The Contour, or Out-line of the Modillion in Profile is defcribed by 3 Centers, thus; its Projection being divided into 6 parts, erect Perpendiculars at 2 and 5; the firft Center will be at 2, with the Radius 2 1; the fecond, 1 and a half below it, and the third 2 and a half above the Point 5. The Projection of the *Cima reverfa* over it, which is the Cap of the Modillion, is expreffed by a dotted Square at the End of the Modillion.

To divide the fquare Pannels in the Sofito of the Cornice, divide the Space between the Caps of the Modillions into 6 parts, as they are numbered; take 1 on each Side for the Border, and the other 4 will remain for the Pannel. Divide out the fame Divifions on the Profile of the Corona at E, and bifect the remaining part for the Drip. The whole Projection being divided into 4, as in the Scale underneath, fubdivide, and determine the Projections of the Members, as there reprefented.

THE upper Figure, next over the Modillion Cornice, is an *Ionick* Dentil Cornice, whofe Height being divided into 4 principal parts, as before, and then

then ſubdivided, the Height of every Member is moſt eaſily determined. It is to be obſerved, that when this Cornice is to be uſed upon Columns or Pilaſters, the *Dentils* muſt be exactly divided by the Semidiameter of the Column as followeth. Suppoſe the Line AB to be the central Line of a Column, divide the Semidiameter of the Column into 12 parts, then make the Breadth of each *Dentil* equal to two of thoſe parts, and the Diſtance between each *Dentil* equal to one of thoſe parts. The central Line of the Column BA, muſt paſs directly through the midſt of a *Dentil*. The Line CD repreſents the Upright of the Column continued, from whence the Projection of the Cornice is accounted, and its Members are determined by its Scale, whoſe Length is equal to its whole Projection divided into 4 Parts, and ſubdivided again as in the Figure expreſſed. It is alſo to be further obſerved, that in caſe this Cornice is to be uſed without Columns in Rooms, or over Doors, Windows, *&c.* to find the Magnitude of the *Dentil*, divide ¼ of the Scale of the Projection of the Cornice into 6 Parts, then take the Length of 7 ſuch parts, and divide it into 5 parts, then take 2 of them for the Breadth of a *Dentil*, and 1 for an Interval, as may be ſeen by the Scale CC.

THE other two Figures on the right Hand Side are *Ionick* Arcades, the upper one without Pedeſtals, the lower one with Pedeſtals; whoſe Intercolumnations are determined by Diameters and parts. The Impoſt to theſe Arcades, is repreſented by Figure A, and the Architrave by Figure B, in Plate CLXIX. on whoſe upper part, is an *Ionick* triumphal Arch, or Gate, of very good Deſign.

Plate CLXX. Ionick *Intercolumnations, with* Ionick *Frontiſpieces, and the* Ionick *Order, on the* Dorick, *by Mr.* GIBBS.

FIGURE B repreſents the Intercolumnations for Portico's, or Colonades, and thoſe of A and C, for Frontiſpieces to Doors or Windows; whoſe ſeveral Diſtances are determined by Diameters and parts.

FIGURES D, E, F, repreſent the *Ionick* on the *Dorick* Order, and the *Dorick* on a ruſticated Baſement, wherein the only Thing to be regarded is, that the ſame central Lines be common to the Columns in both the Orders, that void be over void, and ſolid over ſolid: To which I muſt alſo add, that 'tis abſolutely neceſſary to place a Sub-plinth under the Plinth of the *Ionick* Pedeſtals, to raiſe them higher, ſo that they might be ſeen at a tolerable near Diſtance from the Building, which they cannot be as they are now placed; becauſe the Projection of the Cornice will eclipſe the Plinth. The Like ſhould be alſo obſerved with the Plinths to the Baſes of the *Ionick* Columns, whoſe Heights are in great part eclipſed by the Projection of the Cornice to the Pedeſtals. The little ruſticated Window F, placed in the ruſticated Arch, makes a very poor Figure, and its Architrave being broken by the Ruſtick Blocks, ſeems to be more of the Invention of a Blockhead, than of a real Artiſt.

Plate CLXXI. Venetian *Windows, by* Mr. GIBBS.

THIS Plate repreſents to our View two Deſigns of Windows after the *Venetian* Manner, the lowermoſt of the *Dorick*, the uppermoſt of the *Ionick* Order, whoſe Intercolumnations are expreſſed by Diameters and parts. I muſt here beg leave to obſerve, that when theſe Kind of Windows are ſet in Fronts, where greater Columns are made uſe of, as in the Chancel End of St. *Martin's* Church *in the Fields*, nothing can be ſo ſhocking; for the large Columns and their Entablature, being ſeen at the ſame Time with theſe ſmall ones, they cauſe them to appear much ſmaller than they really are, and conſequently they cannot fail of having a very poor Effect. To remedy this, I would recommend, that an Impoſt only be uſed, inſtead of an Entablature,

placing

placing Pilasters without Capitals under them; nor would I give them any Base, save that of a Plinth on the Window-stool. *To proportion a Window* of this Kind, I would divide the given Breadth into 12 parts, of which I'd give 1 to each of the Pilasters, 2 to each of the side Apertures, and 4 to the middle Aperture. The Height of the middle Aperture, unto the Top of the Impost, from whence the Arch springs, I'd make equal to twice its own Diameter; and that Height being divided into 5 parts, I'd take the upper 1 (which now is made an Entablature) and divide it into an Impost of *Dorick* Composition, and then the Pilasters would consist of 8 diam. in Height. A Window thus composed would be very light, and airy, and an Ornament to a Front, instead of an Eye-sore, where large Columns are introduced; for then there would be no Comparisons made of a small Entablature and its Pilasters with the greater.

Plate CLXXII. *An* Ionick *Dentil Cornice, supported by Trusses, for Doors, Windows,* &c. *by Mr.* GIBBS.

WHEN we are to place Cornices over Doors or Windows, to be supported by Trusses only, and to make such Cornices of this Order, we must first find the proper Height for such Cornices, before that we can proceed to the Division of their Members. Now, to do this, we must divide the Height of the Window into 5 parts, and set up 1 of those parts above the Height of the Window, which will give us the Limit, or Top of the Cornice. *To find the Depth of the Cornice,* divide the Height between the Head of the Window and Top of the Cornice into 10 equal parts; of which take the upper 4 for the Height of the Cornice, and the other 6 being equally divided, give one half to the Freeze, and the other half to the Architrave. The Proceedings thus made, is the same, as if Columns were to be placed under the Entablature, instead of Trusses; so that the next Thing to be found is the Depth and Projection of the Truss, which is as follows: (1) The Height of the upper Volute is equal to the Height of the Freeze, which divide into 7 parts. (2) The Face of the Cornice being described, set the Height of the Freeze from 1, the under part of the lower *Cima reversa,* to 8 r, and from the Point 8 r, draw the Line 8 r D G 8, which is to be taken for the Upright, or Face of the Building, against which the Cornice is placed, and the Distance 1 8 r is the Projection of the *Cima reversa,* under which the Trusses are placed. The Distance, from the under part of the upper Volute, to the upper part of the under Volute, is equal to 4 parts; the Height of the Cornice, and the Depth of the lower Volute, is equal to 2 parts, or half the Height of the Cornice; as also is the Depth of the Leaf underneath it. The Heights of the principal parts being now determined, proceed to describe the Volutes, as follows: (1) The Height of the Eye of the upper Volute is equal to 1 seventh of the Height of the Freeze, whose Center is found by an horizontal Line, drawn from D, the 3d Division, on the upright Line, and another cutting it at Right Angles, drawn from the middle of the 4th part, under the *Cima reversa.* (2) Continue out the Bottom of the *Cima reversa* equal to 1 2, and from thence draw a pricked Line, parallel to the Upright of the Building, for to terminate the swelling, or projecting part of the Volute. This being done, describe the Eye of the Volute, wherein inscribe a Square, and divide its Diameters, each into 4 parts, as represented at the Bottom of the Plate, where the Eye is shewn at large, for the better Understanding of its Divisions, drawing from every Center the several horizontal and perpendicular Lines, as are to determine the Quantity of each Arch of the Volute; and on the respective Centers describing the Arches 1 2, 2 3, 3 4, *&c.* until the Volute is compleated. The Height of the lower Volute being before determined, divide its Height into 7 parts, and make its Projection A B equal to 8 of those parts. The Height of its Eye is equal to 1 of those parts, and stands over the 4th horizontal Division, with its Center exactly against the 4th perpendicular Point. The Centers of this Eye are found in the very same Manner, as those of the other. The Diameters of the Circles, in which the

the Roses are comprised, are each equal to ⅐ of each Volute's Height. *To find the Curve of Communication of the two Volutes*, draw the Line CA from 1 part below the Line GG, and make AC equal to AB, and draw the Line DC, which bisect; then, on the Points C and D, with the Radius 1 D or CG, describe the two Arches, and their Concentricks, which will complete both Volutes. The Breadth of the Front or Face of the Truss must be equal to 7 9ths of the Height of the Freeze, and, it being divided into 7 parts, give 1 to each of the Fillets E, 1 to the Astragal and its Fillets H, and 2 to each of the *Cima recta's* on its Sides. The side Projecture of each Rose, between the Plain of the Truss, is equal to the Breadth of a Fillet.

Plate CLXXIII. *The Base and Cornice to the* Corinthian *Pedestal, geometrically described, by* C. C. OSIO.

BEFORE we can proceed to describe the Mouldings in the Base and Cornice of this Pedestal, we must find their Heights, and, in order thereto, we must have the Height of the Pedestal given, which we'll suppose to be AD, Fig. II. *To find* CD *the Height of the Base, and* AB *the Height of the Capital*, (1) Draw the Lines *e a* and *l k*, through the Points A and D, at Right Angles to AD. (2) Make the Angle *e* DA equal to 30 deg. bisect *e* D in *g*, raise the Perpendicular *g f*, cutting AD in *f*; draw the Line *a f l*, so that the Angle A *f a* be equal to 30 deg. from the Point *h* raise the Perpendicular *h k*, to cut *l k* in *k*; divide the Angle *h k l* into 2 equal Parts, by the Line *i k* cutting AD in C; then is CD the Height of the Base: Also divide the Angle A *a f* into 2 equal Parts, by the Line *a d* B cutting AD in B; then AB is the Height of the Cornice.

The Height of the Base b A, Figure I. *being given, to divide it into its Mouldings.*

CONTINUE out the Base towards *r*, make the Angle A *b r* equal to 30 deg. bisect *b r* in *q*, raise the Perpendicular *q* 2, then is 2 A the Height of the Plinth. Make 2 *o* and A *p*, each equal to 2 *b*, and draw *o p* the Face of the Plinth. Draw *b o*, and divide *b* 2 into 8 parts, at 1, *y*, *x*, *w*, *v*, *t*, *s*; then is *x* 2 the Height of the Torus, *w x* the Fillet, *s w* the *Cima recta*, and *b s* the Astragal. Bisect *y* 1 in *z*, draw *z m* parallel to *o* 2, cutting *b o* in *m* the Center of the Torus; on *f* erect the Perpendicular *f h*, cutting the central Line of the Astragal *h e* in *h*, the Center of the Astragal; from *h*, draw *h k* parallel to *b o*, cutting *k x* in *k*; make *i w* equal to *k x*, and draw *i k* the Face of the Fillet; draw *i g*, and thereon describe the *Cima recta*; on the Center *h*, with the Radius *h g*, describe the Astragal; make *a h* equal to *b e*, and draw *c a* equal to twice *a b*; draw *c d*, and the Whole is completed.

The Height of the Cornice a 2, Figure III. *being given, to divide it into its Mouldings.*

DRAW *e a* at Rt. Angles to *a* 2; make the Angle *e* 2 *a* equal to 30 deg. and draw *e* 2, cutting *a e* in *e*, which is the Projection of the upper List, or Regula. Make *a v* equal to *a e*, and draw *e v*; make *e k* equal to ⅓ of *e* 2; draw *b k* and *k i* continued to *a* 2; make *b d* equal to ⅓ of *b k*, and thro' *d* draw *f d* to the Line *a* 2, *e f* for the Face of the Regula; also bisect *k i* in *h*, draw *g h*, and thereon describe the *Cima reversa*. Bisect *k* 2 in 1, on 1 raise the Perpendicular 1 *s*, bisect *s v* in *t*, make *s r* equal to *s t*, from *r* draw *l r*, and from *i* draw *i l* the Face of the Plat-band; from *t* draw *t z* cutting *e v* in *w*, from whence draw *w* 4 parallel to *a* 2; through *x* (where the Perpendicular 1 *s* cuts the Line *e v*) draw *q z* parallel to *a* 2, which bisect in *y* the Center of the Astragal; from the Point 2 draw the Line 2 7 at Right Angles to *a* 2, cutting the Line *w* 4 in 5; make 6 5 equal to 5 2, and through the Point 6 draw the Line 8 6 parallel to 72; make 7 5 and 8 6 equal to 4 3, then bisect

4 A the

the Diagonal 7 6 for the Center of the Aftragal; the Height of the Fillet 5 4 is equal to half 6 5, which completes the Cornice as required.

Plate CLXXIV. *The* Corinthian *Pedeftal entire, according to the Ancients, by* C. C. Osio.

THE Figures of the laft Plate having taught the Manner of dividing out the Members in the Cornice and Bafe of the Pedeftal, after that their Heights were found, the Manner of which being alfo given there, we are now to find the Diameter of the Die of the Pedeftal, fuppofing that 'tis to be ufed alone for the Support of a Statue, and the Projection of the Plinth to the Bafe of its own Column is unknown. Now it is evident, by the Semicircle defcribed on the Center *b*, in one of its Sides, that the whole Altitude of the Die, is equal to twice its Diameter; therefore having divided the Height of the Die, on its central Line, into 4 equal parts, fet off 1 of thofe parts on each fide of the central Line, and draw the Out-lines of the Die, as required.

Plate CLXXV. *The Bafe of the* Corinthian *Column, according to the Ancients, geometrically defcribed, by* C. C. Osio.

ACCORDING to this Mafter, we are to underftand, that the Ancients gave but 9 diam. and half to the Height of their *Corinthian* Column, of which they gave the ½ to the Height of its Bafe, as *y z* in Fig. I. The Members, into which they divided this Bafe, were the upper Torus B, the upper Scotia D with its Fillet C, the upper Aftragal F with its Fillet E, the lower Aftragal G with its Fillet H, the lower Scotia I with its Fillet K, the lower Torus L, and the Plinth M: Wherein 'tis to be obferved, that, excepting the lower Torus, all the reft is no more than the *Ionick* Bafe. The Cincture A is a part of the Column, not of the Bafe, as I have long fince declared. *To divide d* 23, *the Height of the Bafe, into its Mouldings,* proceed thus: (1) Draw the Lines *g d* and 25 23 at Right Angles to *d* 23. (2) Make the Angle 25 *d* 23 equal to 30 deg. draw *d* 25, which bifect in 18, on which Point erect the Perpendicular 18 21, and from 21 draw 21 22, cutting *d* 25 in the Point 22; make 24 23 equal to 22 21, and draw 22 24, the Face of the Plinth. (3) Divide *d* 21 into 3 equal parts at *r* 13, then is 13 21 the Height of the lower Torus; alfo make *g d* equal to *d r*, and draw *g k*, &c. parallel to *d* 23, to terminate or limit the Projections of the upper *Torus* and *Aftragals*. (4) Divide *d r* into 4 parts, and *d l* will be equal to 3 of them, which is the Height of the upper *Torus*; bifect *d l* in *h*, and from *h* draw *h k*, cutting *g r* in *t*, the Center of the *Torus*, on which defcribe the Semicircle *f k n*. (5) Make *r t* equal to *r l*, and draw *t y* of Length at pleafure; make *l m* and *s t* each equal to ⅙ of *l t*, and draw the Parallels *m o* and *u s* of Length at pleafure. (6) From *t*, the Center of the upper *Torus*, draw *t q*, which terminates the Fillet C, and *Scotia* D; bifect *o q* in *p*, the Center of the Scotia which is femicircular. The two Aftragals F and G, taken together, are equal to *r t*. The Remainders being the two *Fillets* H K, and the *Scotia* I, divide their Height into 8 parts, and give 1 to each Fillet, whofe Projections are determined by the Line *u w*, drawn through the Point of Interfection, made in the Line 25 by the under Line of the Fillet H. The Fillet K hath its Projection determined by the Point 16, where the Line 25 cuts the upper Line of the *Torus*; and thus is the whole Bafe completed as required. *Note*, The Line *d* 23 reprefents the Upright of the Column, whofe Cincture A hath its Height equal to *d h*, half the upper *Torus*, and its Projection is equal to the Diagonal of a Square, whofe Side is equal to its own Height, *viz.* Making *c d* equal to *a d*, on *a*, with the Radius *a c*, defcribe the Arch *c b*, cutting *a b* in *b*, the Projection required.

Plate

Plate CLXXVI. *A Section of the* Corinthian *Capital, geometrically described, by* C. C. OSIO.

THE Height of the Capital being, according to this Master, equal to the Diameter of the Column, let the Line 1 8 represent a given Height, and the central Line of the Column; draw the Lines *f* 1 for the upper part of the Abacus, and *q* 8 for the upper part of the Astragal, at Right Angles to 1 8; divide 1 8 into 7 equal parts, at the Points 2, 3, 4, 5, 6, 7, and draw the Lines 2 15, 4 12, 6 *y*, of Length at Pleasure, and parallel to *f* 1; divide 2 3 into 3 parts, at the Points *d*, *e*, and from *d* draw the Line *d* 28 at Pleasure, and parallel to 2 15; bisect 1 2 in *c*, and from *c* draw the Line *c* 22 at Pleasure; divide 1 *c* into 3, at *a b*, and from *b* draw *b* 17 at Pleasure, and both parallel to *f* 1; make *f* 1 equal to 1 7, that is, to 6 sevenths of 1 8, the Height of the Capital; then will 1 *f* be the utmost Projection of the Abacus. Make *p* 8 equal to the Semidiameter of the Column at its Astragal, and through the Point *p* draw a Line parallel to 1 8, to represent the Upright of the Column; make the Line 15 2, the under part of the Abacus, equal to *f* 1, its upper part, and draw the Lines *f* 15 and 15 8; make *q* 8 equal to 8 5, and draw the Line *q* 5, also draw the Line *f q*, which Line doth limit the Projections of the Leaves and Volute; from *m*, where *q* 5 cuts 15 8, draw *x m* parallel to *y* 6, cutting *f q* in *x*, from whence draw *x y* parallel to 6 8; make *y u* equal to *y x*; then is the Point *u* the utmost Altitude, and the Point *x* the utmost Projection of the first or lowermost Leaves. Bisect 4 5 in *r*, and from *r* draw the Line *r* 10 parallel to 12 4, cutting *f q* in 10, from which Point draw the Line 10 36, S K 32 parallel to 1 8, for the Cathetus of the Volute. Make the Distance 10 *s* equal to half the Distance between the Point 10 and the upright Line of the Column, and draw the Line 31 *s* parallel thereto; also bisect 10 *s* in the Point 11, and make *s* 13 equal to 11 *s*; then are the Points 13, 12, 10, the Points, thro' which the upper part of the upper Leaves must pass. Make 28 35 equal to the Distance between the Point 28 and the upright Line of the Column; and thro' the Point 35, draw the Line 36 F, which is to determine the Depth of the Volute. From the Point D, where the Line *f q* cuts the Line 15 1, draw the Line D H for the horizontal Line of the Volute. Make *f* 17 equal to 1 *b* the Height of the Ovolo, and from the Point 17, thro' A, the Center of the Eye of the Volute, draw the Line 17 A G; also thro' the Point A draw the Line E B at Right Angles to 17 C G. The Diameter of the Eye of the Volute is equal to 1 eighth part of its whole Height, and its Centers are divided out equally, as in Fig. III. being 24 in the Whole, which are numbered, as they are to be used:

So the Point	1 2 3 4 5 6	is the Center of the Arch	32 C C D D E E 36 36 G G H, &c.

The Center of the Arch 32 B is the Point 36; the Remainder may be described by an Arch also, but is usually done by Hand. The Point 16, where the Line 17 G cuts the under Line of the Abacus, determines the Projection of the Abacus; and a Line drawn from the Point 26, where the Line *f q* cuts the aforesaid Line, parallel to the Upright of the Column, as the Line 23 26, determines the Projection of the Fillet. *Lastly*, *f* 18 being made equal to *f* 17, on the Point 18 describe the Ovolo, which compleats the Section.

FIGURE II. is a Plan of the Capital thus described; (1) Let *a c* be the Radius of the greatest Circle, that can be described on the Head of the Capital, between the Extreams of its Projections in Front and Rear, which divide into

5 equal

into 5 equal parts. (2) Make *c b* equal to 1 of thoſe parts, and then compleat a geometrical Square, whoſe Sides are each equal to twice *a b*, that is, to *f d*. (3) Circumſcribe a geometrical Square about the firſt made Square, as here repreſented by dotted Lines; then, on the Points *f* and *d*, with the Side of the Square *f d*, deſcribe the Arches *f g* and *d g*, interſecting in *g*, the Center of the curved Abacus, on which deſcribe the Abacus, until it meet the Sides of the great Square, which are its returned Points.

Plate CLXXVII. *The* Corinthian *Entablature of the Ancients, geometrically deſcribed, by* C. C. OSIO.

(1) IT is here ſuppoſed, that the Line A D is the given Height of the Entablature, and central Line over the Column. (2) Draw the Line *b* D, making the Angle *b* D A equal to 30 deg alſo draw E A at Right Angles to A D, cutting the Line *b* D in *b*; biſect *b* D in 11, and draw the Line 11 *i* parallel to *b* A, cutting A D in *i*; alſo on the Line *b* D, at the Point 11, erect the Perpendicular 11 *b*, cutting A D in *b*; biſect *b i* in *n*, and from *n* draw the Line 9 *n*, of Length at Pleaſure, parallel to *b* A; then is A *n* the Height of the Cornice, which being divided into 3 parts, at 24 20, draw the Line 20 *q*, at Pleaſure, parallel to *b* A, and make *n* C, the Height of the Freeze, equal to 2 thirds of A *n*, the Height of the Cornice; the Remainder C D is the Height of the Architrave. (3) The Line 10 12 5 is the Upright of the Column. *To divide the Architrave into its Mouldings*, make the Angle *y* C D equal to 30 deg. cutting *b* D in *y*, thro' which draw the Line *t y z* at Pleaſure, parallel to 13 C, the upper part of the *Tenia*, which is ſuppoſed to be drawn before at Right Angles to A D. Make *z* 1 one 7th part of *z* D; biſect 1 D in 6; make 6 7 equal to one 6th of 6 D, and from the Points 1, 6, 7, draw Lines at Pleaſure, parallel to 13 C; draw the Line C *y*, alſo the Lines *f* C and *f y*, making the Angles *f* C *y* and *f y* C each equal to 30 deg. which Lines will interſect each other in the Point *f*, from whence draw the Line *f b* parallel to 13 C, cutting C *y* in *b*. Through *b* draw *e c* at Right Angles to C *y*, cutting C *f* in *e*; draw *e d*, making the Angle *b e d* equal to 30 deg. cutting C *y* in *d*; from *d* draw *d c*, making the Angle *b d c* equal to 30 deg. cutting the Line *e b* in *c*; through the Points *c* and *d* draw the Lines *p c a* and *q d b*, of Length at pleaſure, and parallel to 13 C; the Height of the Regula 13 *s* is 1 fourth of the Tenia C *a*, whoſe Projection 13 12 is equal to its Height. *To divide the Height of the Cornice into its Mouldings*; the Lines *q* 20, and E A being drawn before, make B *n* and *b c* each equal to 1 fourth of *b n*, and draw the Lines *c s* and B 6 of Length at Pleaſure, and parallel to 9 *n*; make *n g* 1 third of *n* B, and draw *g* 8; make the Projection of the Freeze 10 *g* and 12 C, each equal to the Semidiameter of the Column at its Aſtragal, and draw the Upright of the Freeze 10 12; make 8 10 equal to twice *g n*, and draw 8 9 the Face of the Fillet; alſo deſcribe the curved Face of the Aſtragal, whoſe Center is in the Line 9 8, being continued; from the utmoſt Projection of the Aſtragal draw the Line 7 *b* parallel to A D, and make 7 *y* equal to half *b* B, and thro' the Point *y* draw the Line *x y e* parallel to 9 *n*; make *w y* equal to 7 *y*; divide *w y* into 4 parts, make *w x* and 6 7 each equal to 1 part, and deſcribe the Face of the Cima. Draw *e f* in any part of the *Cima reverſa*, and divide it into 3 parts; make *e d* equal to 1 part, and through the Point *d* draw the line *s c*, at Pleaſure; make *u d* equal to *w e*, and draw *w u*, continuing it upwards towards 1; make 1 *u* equal to 6 times *w u*, and through the Point 1 draw the Line *p* 1 *a*; make *s u* equal to 2 thirds of 1 *u*, and draw the Line *s r q* parallel to 1 *u*, cutting the Line *p a* in *p*, then is the Parallelogram *p* 1 *s u* the Magnitude of the outer Dentil; make the Dentil 1 2 *u* 4 equal to *p* 1 *s u*. The Intervals between the Dentils, as 2, 3, 4, 5, &c. are each equal to half a Dentil. Make 24 *a*, the Height of the Aſtragal, equal to 1 fifth of the Dentil *a c* whoſe Fillet *o p* is one third Part thereof. The Projection of the Fillet, before

before the Dentil is equal to the Height of the Fillet, and the Center of the Aſtragal is perpendicular over it. Make the Height of the Ovolo 23 24 equal to 1 third of 20 24, and draw the Line 23 1 at Pleaſure, and parallel to 9 *n*; continue the Face of the Fillet to the Aſtragal *o p* to 15, which is the Center of the Ovolo; make 20 21 equal to 1 fifth of 20 23, and from 21 draw the Line 21 *r* of Length at Pleaſure; divide *b g* in *e*; make *e f* equal to 1 fifth of *e g*, then is *f g* the Height of the Corona; make *c e* equal to half *e f*, and thro' *c* draw the Line *z c b*, then is *c f* the Height of the *Cima reverſa* with its Fillet; divide *b c*, the Height of the great *Cymatium*, into 6 parts, and give the upper 1 to the Fillet; make *b* E equal to *b* 7, then is *b* E the Projection of the Cornice; make the Breadth of every Modillion equal to their Height, including their *Cima reverſa*. As the Projections of the two *Cima's* are equal to their own Heights, deſcribe their Out-lines, and from the lower one draw the Face of the Corona, with the *Cima reverſa* of the Modillions underneath it. *To find the Height of the Centers* of the Eyes of the two Volutes to the Modillions, make 10 1 equal to the Height of the Modillion without the *Cima reverſa*, and from the Point 10, draw the Line 10 9 parallel to the Line 8 1, and draw the Diagonals 9 11 1, and 10 11, interſecting each other in 11, which is the Center of the great Volute; draw the Line *u* 12 at 1 third of the Modillion's Height, and making *u t* equal to *s u*, the Point *t* is the Center of the ſmaller Eye. This Maſter proceeds no farther to ſhew how to deſcribe the Volutes, which will be taught hereafter, by other Maſters, in the following Sheets. Fig. I. is the Order entire.

Plate CLXXVIII. Corinthian *Profiles, taken from the Temple of* Jeruſalem, *and the Portico of the Rotunda, according to Mr.* EVELYN.

THE firſt of theſe is certainly the moſt beautiful Order that was ever invented, its Baſe excepted, wherein there is the ſame Abſurdity of ſmall Members, as I have already obſerved in many of our Maſters on the *Ionick* Order; therefore, to make this Order *the Order of Orders*, as Mr. *Evelyn* calls it, we muſt give to it the *Attick* Baſe, which indeed ought to be uſed with the *Corinthian* Order only. The other Profile of the Portico of the Rotunda hath the ſame kind of Baſe, but their Capital and Entablature, which are both very good, are very different in their Leaves, thoſe of the Temple of *Jeruſalem* being like unto Feathers, having their Volutes enriched with Palm-branches, and the other of Acanthus, with plain Volutes.

IF we conſider the Triglyph in the Freeze of the firſt, which is a part of the *Dorick* Enrichment, we are then ſhewn, that in this Order there are all the other *Greek* Orders compriſed; for, beſides the Triglyph, there are alſo the *Ionick* Dentils compriſed in its Bed-moulding, and therefore it may be ſaid to be a *Dorick, Ionick,* and *Corinthian* Compoſition. As to the placing of the Modillions in pairs over each Column, I can ſay but little in its Praiſe, for, where Joiſts are ſo placed in a Building, their Strength of ſupporting is unequally divided. The Height of the Column in both Profiles is 10 diam. and their Members in general are determined by Minutes. As to the Heights of their Architraves and Cornices, they are both equal, but their Freezes are different, that of the Temple of *Jeruſalem* being 54 min. and that of the Rotunda but 43. I muſt alſo remark, that I think the great Cymatium of the Rotunda is really *Tuſcan*, as that it hath no *Cima reverſa* under it.

Plate CLXXIX. *An Altar in the Rotunda.*

THIS Frontiſpiece repreſents a *Corinthian* Altar in the Rotunda, with a circular Pediment, which, being one of the moſt ſimple and grand Compoſitions I ever ſaw, is given here as an Example for Help to Invention.

Plate CLXXX. *The Door of the Rotunda at* Rome.

THE Entablature marked P N, on the left Hand, is the Members at large of the Door, repreſented on the right Hand, and which, being a very grand Compoſition, is given here as a further Help to Invention. The Baſe, placed over the Door, which conſiſts of 3 Torus's, 2 Scotia's, a Plinth, and their Fillets, is from *Serlio*, and taken from the *Rotunda*; but from which part he makes no Mention, and which, I believe, is a very proper Baſe to an Order, when placed very much above the Eye, in all which Caſes the Heights of Members are very much fore-ſhortened.

Plate CLXXXI. *The* Corinthian *Baſe, Capital, and Entablature of the Portico to the Rotunda at* Rome, *deſcribed by equal Parts.*

As many Perſons delight in working by various Methods, this Example is given here for their Entertainment; which is very eaſy to underſtand by a very little Inſpection, the ſeveral Diviſions being very plain to the meaneſt Capacity, and eſpecially to ſuch, who have wiſely examined all the preceding Plates.

Plate CLXXXII. *The* Corinthian *Order within the Rotunda at* Rome.

THIS Plate repreſents a *Corinthian* Column with its Entablature, taken from the Inſide of the Rotunda, whoſe Height being divided into 9 parts, the Entablature poſſeſſes the upper 1, and 6 ninths, or 2 thirds of the next 1. The Height of the Architrave is 5 ninths of the 2d part; the Height of the Cornice is equal to the Diameter of the Column at its Aſtragal, which is diminiſhed $\frac{1}{8}$ of its Diameter at the Baſe; the Remainder is the Height of the Freeze. The Height of the Column is 7 ninths of the whole Height, and one third of one 9th part, which is the part remaining below the Entablature. The Height of the Capital is equal to eight 9ths of 1 of the 9 parts contained in the whole Height; and then, if 7 of the 9 parts of the whole Height, and four 5ths of the 8th part be divided into 9 parts, 1 of thoſe parts will be equal to the Diameter of the Column. Fig. I. is the Plan, and Fig. II. a Section of the Capital at large, divided by equal parts, as therein are expreſſed.

Plate CLXXXIII. *Two* Corinthian *Profiles, taken from the Frontiſpieces of the Bath of* DIOCLESIAN, *and of* NERO, *at* Rome, *according to Mr.* EVELYN.

HERE we are again preſented with two of the moſt noble and rich Entablatures, that perhaps have been yet invented, that of *Diocleſian* being enrich'd to Exceſs, and the other not much ſhort of it. We are here to obſerve, that, altho' many of the Ancients run into that groſs Error of placing double Aſtragals between the 2 Torus's of the Baſe, yet 'tis plain, by theſe two Examples, that it was not generally obſerved; for here, in the Baſe of *Diocleſian*'s, there is but a ſingle Aſtragal, which, tho' bad, is yet much better, than when the ſame Height is divided into two. In the Baſe to the Column of *Nero*, we find both of them baniſhed, it being directly the *Attick* Baſe, which I have all along recommended, and which has an Affinity with the Grandeur and Magnificency of its noble Entablature, whoſe Greatneſs of Parts excels in Majeſty all others, that I have yet ſeen. And as its Architrave conſiſts but of two Faſcia's, and its Cymatium of one great *Cima recta* only, with an *Ovolo* under it, crown its *Corona*; it muſt therefore be never uſed, but to the Out-ſides of Palaces, whilſt the more delicate and rich of *Diocleſian* is received within-ſide, where its beautiful parts are near to the Eye, which without-ſide would not only be loſt at diſtant

diſtant Views, but the tender parts of the Enrichments more liable to early Decay by the Injuries of Weather. The *Cima reverſa*, uſually placed under the great *Cymatium* of the Cornice, is alſo excluded in the Cornice of *Diocleſian*, as I before obſerved it to be in the Columns of the Portico to the Rotunda at *Rome*. The little geometrical Profile contains the Meaſures of thoſe of *Nero*, whoſe Parts, as alſo thoſe of *Diocleſian*'s, are determined by Minutes, and their Projections are accounted from their central Lines.

Plate CLXXXIV. *The firſt Example of the* Corinthian Order, *by* VITRUVIUS.

ALTHO' this great Maſter was happy in the Knowledge of many noble Examples of this Order, built by the antient *Greeks* and *Romans*, yet he as madly runs into the ſame Abſurdity in the Baſe of this Order, as he has done in the Baſe of his *Ionick*. *To proportion this Order to any given Height*, divide the Height into 9 parts, give the upper 1 and 5 9ths of the ſecond to the Height of the Entablature, and then the Remainder being divided into 9 parts (as on the left Hand) 1 of them is equal to the Diameter of the Column, and to the Height of the Capital alſo. The Height of the Cornice is equal to 1 18th part of the entire Height of the Column and Entablature, or to half of the uppermoſt 9th part. The Height of the Architrave is equal to the Semidiameter of the Column, and the remaining part of the Height of the Entablature is the Height of the Freeze. The general parts being thus divided, divide the particular parts as the Diviſions expreſs.

Plate CLXXXV. *A ſecond Example of the* Corinthian Order, *by* VITRUVIUS.

AS the Entablature of the laſt Plate doth not contain any Modillions, we have here an Entablature with Modillions; the general parts of which Order are found as follow: (1) Divide the given Height into 5 parts, and give the upper 1 to the Entablature, (*which I think is too much, as being the ſame Height as is generally given to the* Tuſcan *and* Dorick *Entablatures.*) (2) Divide the under 4 parts into 9, give the upper 1 to the Height of the Capital, and half the lower 1 to the Height of the Baſe. The Diameter is equal to one 9th of the Column's Height. (3) Divide the Height of the Entablature into 10 parts, give the lower 3 to the Architrave, as many to the Freeze, and the upper 4 to the Cornice. The Figures C and E repreſent two *Corinthian* Capitals; that of C having that kind of Leaves which are called *Parſley-leaves*, and the other of the *Acanthus*, or *Branca Urſina*, Bear's Foot. This Capital, its ſaid, was invented by *Callimachus*, an ingenious *Statuary* of *Athens*, by the following Accident: A young Lady of *Corinth* being buried, it happened that on her grave grew a Root or Plant of *Bear's Foot*, on which her Nurſe placed a Basket covered with a Tyle, containing the ſeveral *Toys* with which ſhe uſed to be delighted; the Basket happening to be placed directly on the Plant, its Weight prevented the perpendicular Growth, and compelled it to creep under the Basket, (which 'tis reaſonable to believe was not very heavy) until its Leaves had got to the outſide, when they changed their horizontal Growth to that of perpendicular, quite about the Basket, as repreſented by Figure F; and when the leading Branches of this Plant had grown ſo high as to be again obſtructed, by the covering Tyle, they were then compelled to gently turn about their Extreams, which, together with the Weight of thoſe parts, formed themſelves into an eaſy free Curve, in Imitation of which *Callimachus* made the Scrolls or Volutes of this Capital, dreſſing the lower parts with two Heights of Leaves about a Vaſe, reſembling thoſe about the Basket, which were of different Heights, and gave it its Abacus, in Imitation of the Tyle. Figure B repreſents the Projecture of the Leaves, Volute, and Abacus before

before the Upright of the Column. Figure D is a Plan of the Capital, exhibiting the Curvature of its Abacus.

Plate CLXXXVI. *A third Example of the* Corinthian Order, *by* VITRUVIUS.

THIS third Example (which the Engraver has miſtakenly called the 2d) the Baſe excepted, is a fine Compoſition; its Capital is open and free, and contains 1 diam. in Height excluſive of its Abacus, which is 7 min and half more. The Height of the Abacus above the Aſtragal being divided into 4 parts, the Heights of the Leaves and Volute are from thence determined, as expreſſed in the Figure. *To divide the Entablature into its Architrave, Freeze and Cornice,* divide the Diameter of the Column into 16 parts, of which give 11 and three 4ths to the Architrave, 12 to the Freeze, and 1 diam. 3 parts and half to the Cornice, which together make 2 diam. and 11 parts for the total Height of the Entablature, which is half a Diameter greater than the quarter part of 9 diam. the Height of the Column. The particular Members of the Architrave and Cornice are ſubdivided as expreſſed by the equal Diviſions. This Entablature, as I before obſerved, is of a fine Compoſition, and eſpecially for the Outſide of Buildings, as that its Members are of grand Dimenſions, and the extraordinary Height given to it, I believe, is with reſpect to its Height being much foreſhorten'd, when uſed in very lofty Buildings, when Allowances of this kind ſhould be always given. I muſt own I am in ſome Doubt, whether this Cornice is an Invention of *Vitruvius*, who often proteſts againſt the introducing of *Modillions* and *Dentils* together, as here is done: But however, let who will lay claim to the Invention, certain it is, that the Compoſition is very grand; and here we are alſo to obſerve, that an Ovolo is placed under the *Cymatium* of the Cornice, as in the Example of the Portico to the Rotunda at *Rome*.

Plate CLXXXVII. Corinthian *Intercolumnations, by* VITRUVIUS.

IN this Plate is repreſented, the Intercolunations of Columns for two Kinds of Temples, the upper one conſiſting of ſix Columns, called *Pycnoſtyle*; the other of eight, whoſe Plan is repreſented above by a leſſer Scale, which are both given as Examples for Practice.

Plate CLXXXVIII. *The Temple of* JUPITER, *by* VITRUVIUS.

THIS Plate repreſents a Plan and Elevation of the Temple of *Jupiter*, whoſe Portico's conſiſt of double Rows of Columns, each ten in Front, which, being one of the moſt magnificent Deſigns of the Ancients, is given here for a Help to Invention.

Plates CLXXXIX. CXC. CXCI. *A* Corinthian *Temple, and a Rotunda, by* VITRUVIUS.

THESE three Plates exhibit two different Deſigns, as *firſt*, that of Plate CLXXXIX, which is the Deſign of a *Temple*, with a *Coridore* about it, whoſe Plan is repreſented in the upper part of Plate CXC. And *laſtly*, that of Plate CXCI. which is the Deſign of a *Rotunda*, whoſe Plan is repreſented in the lower part of Pl. CXC. Theſe Deſigns being both very magnificent, and fit to adorn the Gardens of the *greateſt Prince*, are given as Examples for further Help to Invention.

Plate

Plates CXCII. CXCIII. *The* Corinthian Order, *by* A. PALLADIO.

THIS Plate reprefents, (1) The *Corinthian* Pedeftal and Bafe of the Column, in which laft we find two *Aftragals* between the two *Torus's*, but not placed together, as in many of the preceding Examples; and indeed I muft confefs, if we muft be obliged to introduce them, that this is much the beft Way. The Aftragal, placed on the upper Torus, is, I think, not amifs neither, as being a gradual beginning of the impreffed parts of the Bafe. (2) The Capital and Entablature are, beyond all Difpute, of noble Compofition, and efpecially for Infides of Buildings; but fomething againft the Precept of *Vitruvius*, as that its Cornice comprifeth as well *Dentils* as Modillions. The Intercolumnation for Colonades, and of his Arcade with Pedeftals, is very grand, as is the Compofition of the Members in his Impoft and Architrave underneath it. The Height of the Pedeftal is 2 diam. 27 min. of the Bafe to the Column 30 min. of the Column 9 diam. and half, whofe Diminution is one 7th of its Diameter; of the Capital 1 diam. 10 min. and of the Entablature 1 diam. 54 min.

	Diam.	Min.
Pedeftal and Column	11	57
Column and Entablature	11	24
Pedeftal, Column and Entablature	13	51

Plates CXCIV. CXCV. *The* Corinthian Order, *by* V. SCAMOZZI.

THE *Corinthian* Order of this Mafter, who is with many the next beft after *Palladio*, is reprefented in this Plate with all its Embelliſhments. Fig. I. reprefents his Pedeftal and Bafe of the Column, whofe Plinth is made curved, for the better difcharging the Rains from the Cornice of the Pedeftal, which, tho' convenient, looks clumfy, and feems to overload the Cornice. The Members of which his Bafe confifts are the fame as thofe of *Palladio*, but vary fome fmall matter in their Dimenfions. The Capital is of the fame Compofition as *Palladio*'s, the Ornament of the Abacus excepted, which here is a Sun-flower, and that in *Palladio*'s the Tail of a Fiſh. The Entablature, Fig. II. is very different from that of *Palladio*; for, where *Palladio* has a *Cima reverfa* in the *Tenia* of the Architrave, here is a *Cavetto*, and Modillions in the Cornice without Dentils, as are in *Palladio*. On the Side of the Capital ftands a part of its Section, wherein the Heights of the Leaves, and their Curvatures, *&c.* are expreffed by Minutes. The Figures III. and IV. reprefent his greater and leffer Impofts for Arcades, the greater to be ufed in Arcades without Pedeftals, the leffer in Arcades with Pedeftals. Fig. V. is a Profile of the Entablature at large, the Ufe of which is, *To find the Projection of the Cornice over the Miter of a Right Angle*, as follows: (1) From any point in the Line *a b* draw the Right Line *b l*, to make an Angle of 45 deg. with the Upright of the Freeze, then will that Line be equal to the Bafe of the projecting Miter at the Angle; alfo draw the Line *l x*, &c. at Right Angles to *b l*, and from the point *l* fet off the Heights of every Member in the Cornice, that is, make *l m* equal to *p q*; alfo *m n* equal to *q r*; alfo *n o* equal to *r s*; alfo *o w* equal to *s t*; alfo *w x* equal to *t u*; and fo in like manner all the other Members of the Cornice, and from the points *l*, *m*, *n*, *o*, *w*, *x*, &c. draw Right Lines of Length at pleafure. (2) From the points *a*, *d*, *g*, 1, &c. in the Profile, draw Lines parallel to the Line *a b*, until they cut the Line *b l* in the points, *b*, *e*, *g*, &c. then Right Lines being drawn from the points *b*, *e*, *g*, &c. they will terminate the feveral Members at the points *c*, *f*, *g*, *h*, *k*, &c. which will be the very points or Extreams in which the two fide Cornices will meet in the Miter-line of the Angle; and fo in like manner the fame is to be underftood of the Architrave, as alfo of the Mouldings of the Bafe to the Column, and of the Bafe and Cornice to the Pedeftal, as exhibited in Plates CXCVI. CXCVII. Fig.

Fig. VI. reprefents the entire Order, whofe principal parts are the following Heights, *viz.* The Height of the Pedeftal 3 diam. or mod. and 20 min. of the Column, including Bafe and Capital, 10 diam. of which the Bafe contains 30 min. and the Capital 1 diam. 10 min. and of the Entablature 2 diam. which is equal to $\frac{1}{5}$ part of the Column. The particular Members here, as they are alfo in *Palladio's*, are determined by Modules and Minutes. The Diminution of the Shaft is begun at 2 diam. 46 min. above the Bafe, and the Diameter of the Shaft at its Aftragal is equal to 52 min. and a half.

		Diam.	Min.
The Height of the	Pedeftal and Column	13	20
	Column and Entablature	12	00
	Pedeftal, Column and Entablature	15	20

Plates CXCVI. CXCVII. Corinthian *Frontifpieces, by* V. SCAMOZZI.

As in the laft Plate I have explained the Manner of finding the Miter Bracket of the Cornice and Architrave, and have there obferved that the fame Rule is to be followed for finding of the Miters of the Bafe to the Column, when made fquare, and of the Bafe and Cornice to the Pedeftal, I have no need to fay any Thing further thereon ; but fhall proceed to the other parts of this Plate, which confift chiefly but of two Defigns of Frontifpieces for Doors or Windows, the one marked D, with a ftreight Head, part of which is fhewn at large over it ; and the other marked E, with a femicircular Head, whofe feveral Members being expreffed by Modules and Minutes, need no further Explanation.

Plate CXCVIII. Corinthian *Intercolumnations for Portico's to Temples, Arcades,* &c. *by* V. SCAMOZZI.

The two upper Figures reprefent the Profile and Front of a magnificent Temple, that on the Right being the *Portico,* the other on the Left its Profile, which is arcaded in a very grand Manner. As thefe two Figures reprefent unto us the Intercolumnations of this Order without Pedeftals, fo thofe at the Bottom reprefent the proper Intercolumnations in a *Colonade* and *Arcade* with Pedeftals ; all which have their Intercolumnations determined by Modules and Minutes.

Plates CXCIX. CC. *The* Corinthian Order, *by* M. J. BAROZZIO, *of* Vignola.

This Mafter, like many others, has his Faults as vifible as his Beauties, and which I muft own are very furprifing ; for who but himfelf, after having compofed fo grand, fo noble, and fo magnificent an Entablature and Capital, would place them with their Shaft on fo monftrous a Bafe, and that on fo very flender a Pedeftal, whofe Altitude I think is much too high, and which would yet appear higher had he not made a Necking under the Capital, by placing an Aftragal there, which makes its flender Height appear fomething lefs than it really is. The Module by which the Parts of this Order are determined, is the Semidiameter of the Column divided into 18 parts. Before I proceed to the Meafures of the principal parts, I muft beg Leave to obferve, that was the Pedeftal of *Palladio,* with the *Attick* Bafe, given to this Column and Entablature, I much doubt if it could be exceeded by any other Compofition that mortal Man is able to compofe. The Height of the Pedeftal is 3 diam. and $\frac{1}{2}$; that of the Column 10 diam. including its Bafe, which is equal to the Semidiameter ; and the Capital, whofe Height is 1 diam.

and

and one 6th; the Diminution is one 6th of its Diameter at the Bafe, and the Height of the Entablature 2 diam. and half;

		Diam.
The Height of the	Pedeftal and Column	13 ½
	Column and Entablature	12 ½
	Pedeftal, Column and Entablature	16

Plate CCI. *The* Corinthian *Capital, by* M. J. BAROZZIO *of* Vignola, *view'd at an Angle.*

AS the Projection of the Extreams of the Abacus of the *Corinthian* Capital is much greater, when feen in a direct View to an Angle, than to a Side, this Mafter thought it neceffary to exhibit an Elevation and Plan thereof for the Exercife of the young Student, which are here reprefented in Figures I. II. And for his further Exercife I have added Fig. III. which is a fingle Leaf of the *Acanthus* to be copied divers times, by means of which he may foon be able to make a neat Drawing of a Capital of any Dimenfion, when required.

Plates CCII. CCIII. CCIV. *The* Corinthian *Intercolumnations for Colonades, by* M. J. BAROZZIO *of* Vignola.

THE Diftances of thefe Intercolumnations being expreffed by the fame Module, as the Order is proportioned by, there needs no further Explanation.

Plate CCV. *The* Corinthian Order *entire, by* S. SERLIO.

THIS Mafter prefents us with two Examples, that on the right Hand with a *Dentil Cornice*, and the other on the Left with a Modillion *Cornice*. *To find the principal parts of the firft*, divide the given Height into 61 parts, give 10 to the Height of the Entablature, the other 51 to the Height of the Column, including its Bafe and Capital. The Diameter of the Column is equal to 6 of thofe 51 parts. The Height of its Bafe is equal to the Semidiameter, and the Height of the Capital to the Diameter. The Height of the Architrave is equal to the Semidiameter of the Column, as likewife is the Cornice, and the remaining part is the Height of the Freeze. This Order is alfo expreffed by Modules and Minutes in Plates CCXIV. CCXV. *To find the principal parts of the other Example*, divide the given Height into 46 parts, give 9 to the Height of the Pedeftal, 27 to the Height of the Column with its Bafe and Capital, and 7 to the Height of the Entablature. The Diameter of the Column is equal to 3 parts; the Height of the Bafe and Capital the fame as the former. The Height of the Entablature being divided into 19 parts, give 6 to the Height of the Architrave, as many to the Freeze, and the remaining 7 to the Height of the Cornice. The Figure D is a Plan of the Capital, whofe Elevation, and Heights of Leaves, *&c.* are reprefented by Fig. C, and Fig. B is the Out-lines of the Vafe or Bell of the Capital with its Abacus, difengaged of its Leaves, *&c.* The Bafe underneath would have been as well omitted, as inferted, as that its Compofition is after the bad Tafte, of which I have already complained.

Plate CCVI. *The* Corinthian *Entablature, Capital and Bafe at large, by* S. SERLIO.

FROM whence *Serlio* got this Cornice I can't imagine, but furely fuch a heavy Compofition of Members was never before, or fince, applied to this Order: *To divide it into its Architrave, Freeze and Cornice*, divide its Height into 10 parts, give 3 to the Height of the Architrave, as many to the Freeze, and the other 4 to the Cornice. The Members of the Architrave, and of the Cornice,

Cornice are ſub-divided again by equal parts, as expreſſed againſt each part. The Capital on the Left is truly grand, as the Baſe underneath it is truly ridiculous.

Plates CCVII. CCVIII. CCIX. CCX. CCXI. CCXII. CCXIII. *Triumphal Arches, by* S. SERLIO.

PLATE CCVII. repreſents a *Triumphal Arch* of *Serlio*'s own Invention, which would have been very grand had not he broke forward the Entablature over the Columns, and continued the Mouldings of the Baſe to the Column from one to the other. Plate CCVIII. *The Triumphal Arch* at *Ancoven*, wherein are the very ſame Errors as the aforeſaid. The Capital Letters herein refer to the like Letters in Plate CCIX. where thoſe Parts are expreſſed more at large, for the better knowing the ſeveral Members of which they are compoſed, which in many Caſes prove helpful to Invention; for many of the parts of this and the following *Arches* are of very uncommon Compoſitions, and ſome very noble and grand. Plate CCX. *The Triumphal Arch* at *Pola*. As the Columns of this Arch are placed in Pairs, the bringing of the Entablature over them forward, from the Body of the Building, for the Support of Pedeſtals, at A and X, may be diſpenſed with, provided that thoſe Columns advance ſo far clear before the middle part as to admit of Pilaſters behind them, to ſupport the Entablature in the Middle of the Building over the Arch; which otherwiſe, as in this Caſe, can have no other Support, than the inſerted Part of each Column in the Wall, which in the Plan ſeems to be about one third part, and which ought to be one Diameter complete. In ſhort, to have made this Arch truly grand, the Entablature ſhould have been quite entire of one Piece, without any Breakings, forward or backward; nor ſhould the Pedeſtal H be placed directly over the Arch, where it hath the fulleſt Bearing that can be given. The Capital Letters in divers of its parts, refer to the ſame parts expreſſed more at large in Plate CCXI. where you'll find a Capital of good Deſign, and a Cornice very uncommon. Plate CCXII. *The Triumphal Arch* at *Caſtle Vecchio* in *Verona*, which is exactly of the ſame inſipid Taſte as the preceding ones; for here, inſtead of a noble entire Entablature, with a grand Pediment, that ought to have ſpanded all the four Columns, is an Entablature broken into 3 parts, for the Sake of making that poor Pediment over the two middle Columns; which, like many Deſigns of Mr. *Kent*'s *Chimney Pieces*, look more like the Forehead-cloths of Children and old Women, than an Ornament to a Building. The ſeveral Capital Letters refer to the reſpective parts on which they are placed, which in Plate CCXIII. are expreſſed at large; wherein you'll find a very good Baſe to the Column on the Pedeſtal F; Part of the circular Architrave marked B, whoſe Enrichment is very grand, and the Cornice A, whoſe *Corona* is finiſhed with its *Cima reverſa* only, and which I do really think to be the ancient Method of finiſhing Cornices, without the *Cima recta*, as I have already obſerved.

Plates CCXIV. CCXV. *The* Corinthian Order, *by* PALLADIO, SCAMOZZI, BAROZZIO, SERLIO, *and the Reverend* D. BARBARO, *according to Mr.* EVELYN.

THE ſeveral Maſters here aſſembled, have the Members of their Orders in general determined by Modules and Minutes, and their ſeveral Projections accounted from their central Lines. It is here to be obſerved, that among all the Maſters hitherto treated of, none could believe the *Attick Baſe* proper to this Order, the Reverend *Barbaro* only excepted, who with the greateſt Judgment has introduced it.

Plates

Plates CCXVI. CCXVII. *The* Corinthian Order, *by* VIOLA, ALBERTI, CATANEO, DE LORME, *and* BULLANT.

THESE Maſters preſent us with no ſmall Variety of Proportions in their ſeveral Entablatures, ſome affecting thoſe which are very low, as *Alberti, Cataneo* and *Bullant*, and the others of greater Altitude, who alſo proportion their Capitals in the like Manner; but their Baſes in general, though of different Compoſitions, are of the ſame Height. The Meaſure by which all the Members of their Orders are determined, is the Diameter of the Column divided into 60 min. and their Projections are accounted from their central Lines.

Plate CCXVIII. *The* Corinthian Order *entire, with a Pedeſtal at large, by* S. LE CLERC.

THE Module by which this Maſter determines all the Parts of this Order is the Semidiameter of the Column divided into 30 min. The entire Height of the Order is 31 mod. and 5 min. of which 6 mod. and 20 min. is given to the Height of the Pedeſtal, 20 mod. to the Height of the Column, including its Baſe and Capital, and 4 mod. and 15 min. to the Height of the Entablature. The Height of the Baſe is 1 mod. the Height of the Capital 2 mod. and 10 min. and the Diminution of the Shaft is 8 min.

But tho' this Maſter, in his principal parts, tells us, that the Height of the Pedeſtal is 6 mod. and 20 min. yet the Heights of his two Pedeſtals, at the Bottom of this Plate, are, one of 6 mod. 22 min. and the other 6 mod. 25 min. ſo that therein is a Difference of 5 min. which be it either given or taken is not any Thing material. The Height of the Baſe to the Pedeſtal is 1 mod. and 3 min. and Height of its Cornice 25 min. and a half. The Height of the Pedeſtal, which is equal to 1 third of the Column's Height, I cannot but think is too high, and of which I have already complained in *Barozzio*'s *Corinthian* Order: If it was made of 1 mod. leſs, at the leaſt, I think it would have a much better Effect. The Compoſitions of Members in the Baſe and Cornice of both the Pedeſtals are not amiſs; but if the Baſe of the Pedeſtal E was to be uſed with the Capital of the other Pedeſtal on the right Hand, they would be more ſimilar to each other, than the Baſe and Cornice to each now are. The Baſe and Cornice, expreſſed at large againſt the entire Order, are the Baſe and Cornice of the Pedeſtal E, and the Members at large of the Pedeſtal on the right Hand, are expreſſed on the left Hand in Plate CCXIX.

Plate CCXIX. *The* Corinthian *Capital diſſected, with the Entablature, by* S. LE CLERC,

IN this Plate we have a View of every diſtinct part of the Capital, in ſeperate Pieces, which this Maſter thought neceſſary to expreſs more at large than thoſe in the Capital to the Entablature, and which are given as Examples to be oftentimes copied, and conſidered ſingly by themſelves; ſo that in the drawing of a complete Capital every one may be well underſtood in its Place. Towards the Bottom, on the right Hand, is the Capital at large, with its Leaves in Groſs, whoſe Heights and Curvatures are determined by the Subdiviſions againſt them; and, that there might be no Confuſion, there is but one Side of its Vaſe or Bell dreſſed with its Leaves and Volutes, and the other plain; as alſo is its Plan under it. The Entablature is a very good Compoſition, and differs very little from thoſe in Plates CCXX. CCXXI.

Plates CCXX. CCXXI. Corinthian *Entablatures, Capitals and Imposts, by* S. LE CLERC.

THESE two Plates contain five Entablatures of very little Variation, three Capitals, and four Imposts; which, in general, have their Parts determined by Modules and Minutes, as in the preceding Plates.

Plate CCXXII. Corinthian *Imposts, Sofito of Entablature, Key-stones, and various Enrichments for Cablings to fluted Columns, by* S. LE CLERC.

THIS Master being willing to give as many useful Examples of every Kind, as he could, has presented us with two more Imposts, and three Kinds of Architraves, a Key-stone to an Arch, in Front, and in Profile, as also a Plan or Sofito of the Cornice, with the Manner of returning it at an internal and an external Angle, wherein their several Members are determined by Modules and Minutes. On the left Hand of the Plate, in the lowest Part, is a fluted Pilaster, whose Height being divided into 3 Parts, the lower 1 is cabled, which Cablings being oftentimes enriched, this Master has been so good as to give us six different Designs for that Purpose, which for curious inside Finishings are very noble. *To represent a waved or twisted Column,* there are divers other Methods, besides this of this Master, which will be described in the Explanation of the Plate T, after Plate CCCXVIII. *The Method here proposed is as follows.* (1) Describe a Column, as H G, which diminish at Pleasure, and draw F M parallel to G H, for the central Line of the twisted Column; continue the Cincture and Astragal of the Column H G, to the intended twisted Column F M, and make them in both Columns equal. (2) At the Foot of the twisted Column describe a Semicircle AMB, whose Diameter AB make equal to the Diameter of the Column H G. (3) Divide A B into 3 Parts, and make the small Semicircle CED equal in Diameter to the middle Part, whose Circumference being divided into 4 equal Parts, from thence draw Right Lines parallel to F M, as IC, LD, and the others between them. (4) Divide the Height of the Column HG, into 48 equal Parts, and from thence draw Right Lines parallel to the Base GM, of Lengths at Pleasure, cutting through the Lines IC, FM, LD, *&c.* and forming 4 small Parallelograms between the Lines IC, and LD, in every 48th Division of the Height. (5) From the Point M, trace a curve Line, through every opposite Angle of each Parallelogram, to N, thence to O, and so in like Manner from Side to Side until you arrive at F. (6) From this curved central Line, set on both its Sides, on every parallel Line contained in the whole Height, the Semidiameter of the Column, as it is cut by every such Line, which are as so many Ordinates, by Means of which you will diminish the twisted Column in the same Proportion as the Column H G, and then curved Lines being traced through the several Points, will be the Out-lines of the Column required.

Plate CCXXIII. Corinthian *Intercolumnations, with Enrichments for Cima's, Ovolo's, Cavetto's, &c. by* S. LE CLERC.

THE Intercolumnations represented in this Plate are of five Kinds, *viz.* one for Colonades and four for Arcades, of which two are with Pedestals and two without, whose several Dimensions are expressed by Modules and Minutes. On the left Hand are divers single Mouldings enriched, by Help of which such Kinds of Members may be enriched, as the Nature of the Design and its Situation may require.

Plate

Plate CCXXIV. Corinthian *Arcades*, *by* S. LE CLERC.

THIS Plate reprefents four noble Arcades, of which one is without Pedeftals, one with a Sub-plinth inftead of a Pedeftal, which is to be ufed when the Columns themfelves will not rife to the required Height, and when the additional Height of Pedeftals would be too great (this Arcade is the lowermoft on the left Hand Side) and two with Pedeftals, the Dimenfions of which are expreffed by Modules and Minutes.

Plate CCXXV. Corinthian *Frontifpieces*, *by* S. LE CLERC.

THE Frontifpieces exhibited in this Plate are of very great Invention, of which that on the Left, at the Bottom of the Plate, is a fine Defign for a Triumphal Arch, or Gate, to the grand Entrance of a Nobleman's Palace; and thofe on the right Hand are very noble Defigns for Green-houfes or Banqueting-rooms, *&c.* in Gardens. The uppermoft Figures reprefent, *firft*, the manner of placing a Door with a Window over it, between the Columns of one Order, that includes the Height of two Stories, and, *laftly*, the Section of a Pediment, demonftrating, that the Upright or Naked of the *Tympanum* of a Pediment A muft ftand perpendicularly over the Upright or Naked of the Freeze B, as the Freeze muft alfo ftand perpendicularly over the Upright or Naked of the Column.

Plate CCXXVI. *The* Corinthian Order, *by* C. PERAULT.

THE Module by which this Order is proportioned is a third part of the Diameter of the Column (equal to 20 min.) and, *to proportion this Order entire, to any given Height,* divide the Height into 43 parts, give 9 to the Height of the Pedeftal, 28 to the Height of the Column, including its Bafe and Capital, and 6 to the Height of the Entablature. The Height of the Bafe is 1 mod. and half, equal to the Semidiameter of the Column, and the Height of the Capital to 3 mod. and half. The Diminution is 1 7th of its Diameter at the Bafe, which is equal to 3 mod. or 3 of the 43 parts, into which the whole Height is divided. *To find the Height of the Cornice and Bafe to the Pedeftal,* divide the Height into 4 parts, give the lower 1 to the Height of the Bafe, and half the upper 1 to the Height of the Cornice.

To divide the Mouldings of the Bafe to the Pedeftal.

(1) DIVIDE its Height into 3 parts, give the lower 2 to the Height of the Plinth, and the upper 1 to the Height of its Mouldings. (2) Divide *d e*, the Height of its Mouldings, into 3 parts, and give the upper 1 to the Height of the *Cima inverfa* with its Fillet, which is 1 fourth of its Height. (3). Divide the lower 2 parts into 6 parts, give the upper 3 to the *Cima recta* and the lower 3 to the Torus and Fillet of the *Cima*, which Fillet is one half of the upper 1. The Projection of thefe Members are equal to their Height, as demonftrated by the Semicircle *m n o*.

To divide the Mouldings of the Cornice to the Pedeftal.

DIVIDE the Height into 11 parts, give 1 to the *Regula*. 2 to the *Cima inverfa*, 3 to the *Plat-band*, as many to the *Ovolo*, half of 1 to the Fillet, and the remaining 1 and a half to the lower *Cima inverfa*. *To find the Projection of the Die*, divide *i f*, the Semidiameter of the Column, into 3 parts, and make *k i* equal to 1 of thofe parts, then will *k f* be equal to *q g*, and *m d* the Projection of the Die; continue *q m* to *c*, and divide *a c*, which is equal to the Projection of the Bafe, before the Upright of the *Die*, into 7 parts, and

and make *b a* equal to 1 of thofe parts, then from every other part draw up Lines to the Cornice, parallel to the Line *k q m c*, which terminate the Projections of the feveral Members in the *Bafe* and *Cornice*. *To divide the Members in the Bafe to the Column*, (which are of a horrid Compofition, there being the fmall *Aftragals* between the two *Torus's*, as I have obferved in many other Mafters) divide the Height of the Bafe into 4 parts, and give the lower 1 to the Height of the Plinth; divide the other 3 into 4 parts, give the lower 1 to the Height of the lower Torus; divide the other 3 into 4 parts, give the upper 1 to the upper Torus; divide the other 3 into 4 parts, give the upper and lower 1 and a half to the upper and lower Scotia's, including both Fillets to each; the part remaining divide into 2, and give 1 to each Aftragal; divide the Height of each Scotia, with its Fillet, into 4 parts, and give 1 part to the Height of each Fillet: This Mafter takes no Notice of the Height of the Cincture, which fhould be a fourth part of the Height of the upper *Torus*. *To find the Heights of the Parts of the Capital*, divide *p q*, which is equal to its Height, into 7 parts, and give the upper 1 to *n o*, the Height of the *Abacus*; divide *n o* into 2 equal parts, and give the upper 1 to the Height of the Ovolo, the other 1 being divided into 3, give the upper 1 to the Height of the Fillet; the Points *q*, *t*, *s*, are each at 1 mod. Diftance, and which determine the Height of the Leaves; the upper great Divifion *r s* being divided into 6 parts, the Height of the firft 2 terminates the upper Leaves, and under part of the Volutes.

To divide the Entablature into its Architrave, Freeze and Cornice.

DIVIDE the Height into 20 parts, give 6 to the Architrave, as many to the Freeze, and 8 to the Cornice; the Subdivifions of the lower 5 parts of the Architrave into twice 9, and Cornice into 10, being very plain, needs no more to be faid, excepting that the Projection of the Cornice is equal to its Height.

Plate CCXXVII. *The* Corinthian Order *entire, by* J. MAU-CLERC.

IN this Plate is reprefented, *firft*, the *Corinthian* Order entire on the Right, with two Varieties of Cornices, and, *laftly*, the Column with its Entablature only; the principal parts of which Orders are found as following, *To find the Parts of the entire Order*, (1) Divide the Height into 9 parts, and give the lower 2 to the Height of the Pedeftal. (2) Divide the other 7 parts into 5, and give the upper 1 to the Entablature, and lower 4 to the Column. (3) Divide the Height of the Column into 9 parts, take 1 for the Diameter of the Column, and give the upper 1 to the Height of the Capital; the Diminution of the Shaft is 1 6th of the Diameter. *To find the principal Parts of the other Order, with its Column and Entablature*, divide the Height into 43 parts, give 36 to the Height of the Column, with its Bafe and Capital, and the remaining 7 to the Entablature; the Height of the Capital is equal to 4 of thofe parts, as alfo is the Diameter of the Column, whofe Diminution is 1 6th as the other.

Plate CCXXVIII. *The firft Example of the* Corinthian Order, *by* J. MAU-CLERC.

THIS Order of *J. Mau-clerc* is of tolerable good Defign, and would have made a much better Figure than it doth if the two upper Fafcia's of the Architrave had not fuch great Projections as they have (which, by his Leave, are much too great) and he had left out thofe filly Aftragals in the Bafe of the Column: The Capital is good, and which being defcribed more at large in Plate CCXXIX. is very grand: The Cornice is alfo good, but I think it more fit for the *Ionick* than the *Corinthian* Order, becaufe the Dentils are parti-

particularly adapted to the *Ionick*. *The Height of the Base to the Column* being divided into 4 parts, give the lower 1 to the Plinth, and the remaining 3 parts being divided into 5 parts, give the upper 1 to the Height of the upper *Torus*, and the lower 1 and 1 5th of the 2d to the Height of the lower *Torus*; the remaining being divided into 12 parts, give 3 4ths of 1 to the lower Fillet, half the upper 1 to the upper Fillet, 1 to each Aſtragal, and 3 three 4ths to each *Scotia*. *To find the Projection of the Plinth*, before the Upright of the Column, divide the Diameter of the Column into 16 parts, and make the Projection equal to 3 of thoſe parts; the Height of the Capital being divided into 7 parts, give the upper 1 to the Abacus, the lower 6 to the Leaves and Volutes. The Projection of the *Abacus* is nearly equal to the Projection of the Plinth. *The Height of the Architrave* is equal to the Semidiameter of the Column, whoſe *Tenia* is a 7th of its Height; the remaining Height divided into 12, give 3 to the lower, 4 to the Middle, and 5 to the upper Faſcia's; the remaining part of the Entablature being divided into 2 parts, give the lower 1 to the Freeze, and the other to the Cornice.

To divide the Members of the Cornice.

(1) MAKE the Height of the *Cima reverſa* equal to an 8th of the whole Height, and the Fillet a 3d of the Cima. (2) Make the Height of the Dentils equal to a 5th of the whole Height, as alſo the *Ovolo*, with the Fillet of the Dentils included, which Fillet is equal to a 6th of the Height of the Dentils; the remaining Height being divided into 17 parts, give the upper 1 to the Height of the *Regula*, and the next 8 to the Height of the *Cima recta*; then the Height of the remaining 8 being divided into 3, give the upper 1 to the *Cima reverſa*, and lower 2 to the *Corona*; *laſtly*, The Projection is equal to its Height, and thus is the whole Entablature completed.

Plate CCXXIX. *The* Corinthian *Baſe (at large, enriched) and Capital, by* J. MAU-CLERC.

THE Baſe here repreſented conſiſts of the ſame Members as the preceding, and is divided in the ſame manner; ſo that the only Reaſon of repreſenting it here again at large, is for nothing elſe but to ſhew, how to enrich ſuch Members with carved Ornaments, when required. The Capital repreſented in the upper part of the Plate, is one 14th part greater Altitude than the preceding, and one of the beſt I have ſeen. Fig. S repreſents a Front View of one Angle of the Abacus, with its Volutes.

Plate CCXXX. *A perſpective View of another Kind of* Corinthian *Baſe and Capital, with* Corinthian *Impoſts, by* J. MAU-CLERC.

THE Members of the Baſe repreſented here have ſome Difference in their Heights from thoſe of the foregoing Baſe, but the Kinds are the ſame; indeed we have here an Aſtragal placed on the upper *Torus*, which is not in the other. *To divide this Baſe into its Mouldings*, divide the Height into 9 parts, give the lower 3 to the *Plinth*, the next 2 to the *Torus*, the upper 1 and a 3d of the next to the upper *Torus*, and then the Remainder being divided into 8 parts, give to each of the other Members ſuch of thoſe parts as thoſe Diviſions expreſs. As the Members I have now divided are thoſe which make the Baſe, excluſive of the Aſtragal and Cincture, which this Maſter makes a part of the Shaft, I think it neceſſary to add, that the Height of the Aſtragal and Cincture taken together are equal to a 9th of the Baſe, and which being divided into 5 parts, give 2 to the Aſtragal, and 3 to the Cincture.

THE Capital here repreſented is another grand and elegant Compoſition, and the twining together the two *Helices*, or ſmall Volutes, is admirable good. The Enrichment of the Abacus, with the ſingle Pink in its Middle, is

very noble and rich; but ſuch carved Ornaments in an Abacus are only to be uſed in inſide Works, as that the Angles of ſuch Carvings, ſo openly expoſed, are the moſt liable to an early Decay.

THE Impoſts are both very good, but methinks they ſeem to have been taken from *Palladio* and *Barozzio*.

Plates CCXXXI. CCXXXII. *The principal Members of the Pedeſtal, Column and Entablature, by* J. MAU-CLERC.

THESE principal parts are the ſame as thoſe repreſented before in the entire Order of Plate CCXXVII. which are ſeverally divided as following: Plate CCXXXII. divide the Height of the Pedeſtal into 9 equal Parts, give the lower 1 to the Baſe, the upper 1 to the Cornice, and the intermediate 7 to the Die. *To divide the Height of the Baſe into its Members,* divide the Height into 5, give the lower 2 to the Plinth, and the remaining 3 being divided into 4, give the lower 1 to the Torus, and upper 1 to the Aſtragal and Fillet, which divide into 3, give the upper 1 to the Fillet, and the lower 2 to the Aſtragal; the Remainder being divided into 5, give the lower 1 to the Fillet on the Torus, and the other 4 to the *Cima recta.* Divide the Height of the *Die* into 5 parts, and make its Diameter equal to 3, which divide into 6 equal parts, and give 1 to the Projection of the Baſe, before the Upright or Face of the Die. *To divide the Height of the Cornice into its Members,* divide the Height into 2 parts, give the upper 1 to the Faſcia or Platband, with the *Cima reverſa* and its *Regula,* which make equal to 1 third thereof; the lower 1 being divided into 4, give the lower 1 to the Height of the lower *Cima reverſa,* and the remaining 3 being divided into 2, give the upper 1 to the *Ovolo,* and the lower 1 to the Cavetto and its Fillet. On the Right of the Pedeſtal this Maſter has varied the Members in the Cornice, having placed an Aſtragal on the Top, which on the left Side is a *Cima reverſa* The Baſe to the Column, Plate CCXXXI. is the ſame as in the preceding Plates, as alſo is the Capital; but the two Examples of Cornices are different. *To divide the Height of the Entablature into its Architrave, Freeze and Cornice,* divide the Height into 10 parts, give 3 to the Architrave, as many to the Freeze, and 4 to the Cornice. The *Tenia* of the Architrave is a 7th of its Height, and the Remainder being divided into 12 parts, give 3 to the firſt, 4 to the ſecond, and 5 to the third *Faſcia. To divide the Cornice on the left Hand,* divide the Height into 10 parts, and ſub-divide them as therein expreſſed; ſo in like manner, *To divide the Cornice on the right Hand,* divide the Height into 5 parts, and ſub-divide as the Diviſions exhibit. The Projections of both are equal to their Altitudes. The Diminution of the Shaft is a 6th of its Diameter.

Plates CCXXXIII. CCXXXIV. CCXXXV. *Three* Corinthian *Entablatures enriched, by* J. MAU-CLERC.

THESE Entablatures are the three laſt deſcribed more at large, with many of their Members very finely enriched, which are given here as further Helps to the inventing of Ornaments for enriching ſuch Members, when required.

Plates CCXXXVI. CCXXXVII. *The* Corinthian Order, *by* INIGO JONES, *in the Front of* Somerſet-houſe, *next the River* Thames.

THE ſeveral Members of this Order, and its Intercolumnation, are expreſſed by Feet, Inches and Parts, as the *Tuſcan, Dorick* and *Ionick* Orders of this Maſter are.

Plates

Plates CCXXXVIII. CCXXXIX. *The* Corinthian Order *of Sir* C. WREN, *in the Portico of St.* Paul's *Cathedral in* London.

THE other Orders of this great Mafter having their parts expreffed by Feet, Inches and Parts, I have alfo reprefented this Order and its Intercolumnations in like manner, which were taken by me with the greateft Exactnefs and Care.

Plate CXL. *The* Corinthian Order *entire, with the Pedeftal and Bafe to the Column at large, by Mr.* GIBBS.

To proportion this Order entire, (1) Divide the Height into 5 equal parts, give the lower 1 to the Height of the Pedeftal, and the remaining Height being divided into 6 parts, give the upper 1 to the Height of the Entablature, and the lower 5 to the Height of the Column, including its Bafe and Capital. (2) Divide the Height of the Column into 10 parts, and take 1 for the Diameter; the Diminution of the Column is a 6th of its Diameter, and the Height of the Capital is 1 diam and a 6th.

To divide the Height of the Pedeftal into its Bafe, Die and Cornice.

(1) DIVIDE the given Height into 4 parts, give the lower 1 to the Height of the Plinth, a 3d of the next 1 to the Height of its Mouldings, and half the upper 1 to the Height of the Cornice. (2) Divide the Height of the Mouldings into 4 parts, give the lower 1 to the *Torus*, and a 3d of the next 1 to its *Fillet*; give half the upper 1 to the *Cavetto*, the other half being divided into 3, give the upper 1 to the Fillet, and the lower 2 to the *Aftragal*; the remaining 1 and two 3ds is the Height of the *Cima recta*. *To divide the Mouldings of the Cornice*, divide the Height into 6 parts, give half the lower 1 to the *Cavetto*, the other half being divided into 3, give the lower 1 to the *Fillet*, and the upper 2 to the *Aftragal*; give the next two 6th parts to the Height of the *Cima recta* and its *Fillet*, whofe Fillet is a 6th; divide the upper 2 into 6 parts, give the upper 1 and a 3d to the *Regula*, the next 2 and two 3ds to the *Cima reverfa*, and the next 1 to the *Aftragal*: Thefe Members have not the Divifions of their parts reprefented here, as being fhewn at large by Fig. Q in Plate CCXLIII. *The Height of the Bafe* is equal to the Semidiameter of the Column, which is alfo reprefented at large by Fig. P, Plate CCXLIII.

To divide the Moulding of the Bafe.

(1) DIVIDE the Height into 3 parts, give the lower 1 to the *Plinth*. (2) Divide the other 2 into 10 parts, give 3 to the Torus, 1 to its Aftragal and Fillet, of which the Fillet is a 3d, 3 to the Scotia, including the *Fillet* of the upper *Aftragal* (which Fillet is a 3d of 1 part) and the upper 2 and a 3d to the upper Torus. *The Projection of the Plinth* is equal to its Height, which divide into 5 parts, make the Projection of the Fillet to the upper Aftragal equal to two 3ds, and of the lower to three 5ths. The Projections of the Aftragals and Torus's, beyond the Fillets, are equal to their own Semidiameters. *To defcribe the Scotia*, continue down the Face of the Fillet to the upper Aftragal, unto the Fillet of the lower Aftragal, which divide into 7 parts; from the 3 Divifions draw a Line parallel to the Plinth, cutting the Continuation of the Face of the Fillet to the lower Aftragal, which Line continue upwards, equal to the Difference between the Projections of thofe Fillets, and then a Line drawn from thence, thro' the third Point, will determine the Quantities of the two Arches which compofe the *Scotia*, the firft of which is defcribed on the third Point, and the laft on the Extream of the Line aforefaid.

ſaid. The Shaft of this Column is divided into 24 Flutes, and as many Fillets as in the *Ionick*. The Aſtragal and Cincture are equal to two 3ds of the upper Torus, which being divided into 3, give 2 to the Aſtragal, and 1 to the Cincture. The Diminution of the Column is a 6th of the Diameter.

Plate CCXLI. *The* Corinthian *Capital, by Mr.* GIBBS.

THE Height of this Capital is 1 diam. and a 6th, which laſt is given to the Height of the *Abacus*, and the remaining Height being divided into 3, and thoſe ſubdivided into 4, the Heights of the Leaves are from thence determined. The Aſtragal, with its Fillet, is equal to a 4th of the lower Diviſion of the Leaves, which divided into 3, give 2 to the Aſtragal and 1 to the Fillet. The Scale under the Capital, numbered from 1 to 6, towards the left Hand, is equal to the Semidiameter of the Column, and which being cut in the fifth Diviſion by the Upright of the Column, ſhews that its Diminution is a 6th as aforeſaid. The next two parts from 6 to 8, ſhews the utmoſt Projection of the *Abacus*; and the next Diviſion to 9 is the angular Point from the central Line, equal to half the Side of a geometrical Square, in which you may deſcribe the Plan of the Capital, as here repreſented. Fig. 3 is a Profile and direct View of one Angle of the Volutes of the Capital.

Plates CCXLII. CCXLIII. *The* Corinthian *Entablature, by Mr.* GIBBS.

TO divide this Entablature into its *Architrave, Freeze* and *Cornice*, divide the Height into 10 parts, give 3 to the Architrave, as many to the *Freeze*, and the upper 4 to the *Cornice*. *To divide the Architrave*, Fig. R, Plate CCXLIII. divide the Height into 5 parts, give the lower 1 to the firſt *Faſcia* with the *Bead*, which is a 4th thereof, the ſecond 1 to the ſecond *Faſcia*, the next 2 to the third Faſcia, including the *Cima reverſa*, which is a 6th, and the Bead under the Tenia, which is an 8th; the upper 1 being divided into 4 parts, give the upper part and a 3d to the Regula of the Tenia, and the Remainder to its *Cima reverſa*. *The Projection of the Architrave* is equal to the Height of the Tenia with its Bead, which divided into 5 equal parts, the Projections of the *Cima* in the *Tenia*, the Faſcia's, *&c.* are determined. *To divide the Mouldings of the Cornice*, divide the Height into 5 parts, and ſubdivide each part as is exhibited. *To find the Projections of the Members*, divide the whole Projection into 4 parts, as is done againſt the Freeze in Plate CCXLIII. and ſubdivide each Part, as therein expreſſed, from which Diviſions give to each Member its Projection, as exhibited. The Scale under the Entablature, in Plate CCXLII. is equal to the Diameter of the Column, which is divided into 12 parts, by which the Modillions and their Intervals in the Plan of the Cornice are determined.

Note, The Breadth of every Member in ſuch a Plan is equal to its Projection.

Plate CCXLIV. Corinthian *Intercolumnations for Portico's and Colonades, with the Impoſt and Architrave for Arcades; alſo the* Corinthian *on the* Ionick Order, *by Mr.* GIBBS.

THE Figure C repreſents the various Intercolumnations of this Order proper for *Portico's* and *Colonades*, whoſe Meaſures are expreſſed by Diameters. The Figures A and B repreſent the Impoſts and Architrave of the Arcade, whoſe Members are determined by the Height of the Impoſt (which is equal to the Semidiameter of the Column) divided into 3 parts, and ſubdivided as required. The Aſtragal is equal to half one 3d part of the Height of the Impoſt.

poſt. The Projection of the Impoſt is equal to a 3d of its Height, and that of the Architrave to eight 9ths of the ſame, whoſe Faſcia's are divided, by dividing its Height or Breadth (which is always equal to the Semidiameter of the Column) into 3 parts, and ſubdividing them as exhibited. Figure DEF repreſents the *Ionick* and *Corinthian* Orders on a Ruſtick Baſement, whoſe Height may be conſidered as *Tuſcan* or *Dorick*. It's to be here obſerved, where we place one entire Order over another, either arcaded or otherwiſe, that in ſuch Caſes the Heights of Pedeſtals muſt be leſs than a 5th of the whole Height; otherwiſe, the Stools of the Windows would be too high; and eſpecially when the Columns are of a large Diameter. In theſe Examples, the Height of each order is divided into 7 Parts, of which the Pedeſtal contains the firſt, and the Entablature the laſt. On the left Side of Plate CCXLVII. is the ſame Order on a Ruſtick Baſement, where the Intercolumnations are ſomething different; the other being arcaded, and this not: But the Heights of the Pedeſtals are regulated here as in the other. The Intercolumnations on the right Hand of this Plate are the *Ionick* and *Corinthian* on the *Dorick*, which laſt gives the Rule to the other two, becauſe of its *Metops* and *Triglyphs*, whoſe Intercolumnations are expreſſed by Diameters and parts.

Plates CCXLV. CCXLVI. Corinthian *Doors, and Arcades by Mr.* GIBBS.

IN Plate CCXLV. we have ſix Deſigns for Doors, of which the upper two are ſquare headed with Pediments; the others below are arcaded, either with Pediments or Balluſtrades, wherein 'tis to be obſerved, that the Height of the Balluſtrade is equal to the Height of the Entablature. Theſe Deſigns are in general very good, and worthy of Imitation. The Arcades in Plate CCXLVI. are of two Kinds, the upper one being without Pedeſtals, the other with Pedeſtals, whoſe Intercolumnations are expreſſed by Diameters and parts.

Plate CCXLVII. *The* Ionick *and* Corinthian Orders, *on the* Dorick Order, *by Mr.* GIBBS.

THIS Plate is explained in the Explanation of Plate CCXLIV.

Plate CCXLVIII. *The* Compoſite *Pedeſtal, Geometrically deſcribed, according to the Ancients, by* C. C. OSIO.

THE Height AE being given, biſect it in C, and make the Angle AC*a* equal to 30 deg. Draw *w* E and A *a* at Right Angles to AE, and each of Length at Pleaſure; then will C*a* cut A*a* in *a*, which is the utmoſt Projection of the Cornice. Biſect A*a* in *b*, make the Angle A*bc* equal to 30 deg. cutting AE in *c*, on *c* erect the Perpendicular *ce*, of Length at Pleaſure, and from A draw A*e*, making the Angle *e*A*c* equal to 30 deg. on *e*A erect the Perpendicular *ed*, cutting AE in *d*, then is A*d* the Height of the Cornice. Make ED equal to A*d*, then is DE the Height of the Baſe. Divide BE into 4 Parts, ſet 1 of thoſe parts on each Side the central Line for the Projection of the Die. *To divide the Height of the Baſe into its Mouldings*, draw the Lines *aq* and *au*, making an Angle of 30 deg. biſect *au* in *l*; make the Angle *alk* equal to 30 deg. then will *lk* cut *aq* in *ki*; biſect *kl* in *z*, on *z* raiſe the Perpendicular *zp*, cutting *aq* in *p*; divide *kp* and *ak*, each into 4, then is *qp* the Plinth, *po* the Torus, *ok* its Fillet, *km* the *Cima inverſa*, and *ma* the Aſtragal. The Projection of the Plinth is equal to the Height of all the Mouldings above it. The Mouldings to its Baſe may be alſo divided very eaſily, as follows; divide the Height into 12 parts, give 4 to the *Plinth*, 3 to the *Torus*, 1 to its *Fillet*, 3 to its *Cima inverſa*, and 1 to the *Aſtragal*. *To divide the Mouldings of the Cornice*. The upper *Cima inverſa*, with its Fillet, is a 6th of the Height, of which the Fillet is a 3d; the Height of the Aſtragal is a

12th of the Height, exclusive of its Fillet, which is equal to a 3d of the Astragal. The Height of the Neck *n z* is equal to a 3d of the Height. Bisect 8 *n*, and the upper half is the Height of the Fascia, the lower half being divided into 2, the upper 1 is the Ovolo, the lower 1 is the Cavetto with its Fillet, which is a third part. Make the Angle *i z* 6 equal to 30 deg. and draw the Line *z i*, cutting *i* A *a* in *i*, then will *i* A be equal to A*a*, the Projection of the Cornice being found.

P. *I observe you call the* Cima, *or the upper Member of this Pedestal, sometimes* reversa, *and at other times* inversa, *pray why is it called by different Names, when the Moulding is the same?*

M. THE Moulding is indeed the same; 'tis call'd *reversa* when used in any of the upper parts of an Order, and is always placed with the Fillet uppermost, but *inversa* when 'tis inverted or turned upside down, which can never happen any where but in Bases.

Plate CCXLIX. *The Base to the* Composite *Column, with a Section of its Capital, by* C. C. OSIO.

THE Height of the Base is (as of all other Masters) equal to the Semidiameter of the Column, and its Members are thus divided. Fig. I. The Height of the Plinth IC is a 3d of the whole Height. The Height of the Torus IH is a 3d of the Remainder. Divide AH into 8 parts, and give the upper 3 to the Height of the *Torus*, the next 2 to the Scotia with both its Fillets, each of which is an 8th of its Height; the next three 4ths to the Astragal, including its Fillet, which is a 3d, and the remaining 2 one 4th to the Scotia and Fillet, which is an 8th of its Height. The Projection of the upper *Torus* is equal to AD, and the Projection of the *Astragal* is the same. Draw the Line AB, making the Angle CAB equal to 30 deg. cutting I *x*, the Height of the Plinth, in *x*, then is I *x* the Projection of the Plinth. The Projections of the Fillets to the *Torus's* and Astragals are perpendicular to their Centers. *To describe the lower Scotia,* draw *w s r*; *to divide the Height of the Scotia into two parts, cutting* AB *in r,* draw *po* perpendicular to *w r*, then are the Points *o* and *r* the Centers, on which describe the Arch *p s* and *s u*. The upper Scotia is a Semicircle, which completes the Whole.

To describe the Capital, Figure II.

(1) DIVIDE the Height AC (which is equal to the Diameter and a 6th) into 7 parts at the Points *n, i, k, f,* L, *b,* A; make A *d* equal to a 3d of A *b*, and divide A *d* into 4 parts; also divide *b* L into 3 parts at *c e*; make LM equal to a 3d of L *f*, and *b* M a 4th thereof; bisect *f k* in *g*, and make *i l* equal to a 4th of *i n*; these being done, from the Points A, *a, d, b, c, e,* L, *h,* M, *f, g, k, i, l, n,* C, draw Right Lines out at Pleasure at Right Angles to AC, then will the Height of the several Members be divided. (2) Make B A and 8o *b* each equal to *b* C, then is B A the utmost Projection of the Cornice. Make 8o 7 equal to 4 8o, and draw the Line 6 7 parallel to 4 8o, for the Upright of the Fascia; draw the Diagonal 4 7, which bisect in 5, the Center of the Curve 2 8, and the Line 5 2 1 terminates the Fillet. (3) Make *s* H equal to half M *f*, and complete the geometrical Square *w s t* H, then the Side *t w*, being continued, terminates the Fillet of the Astragal, whose Projection before it is half its own Height. Through the Points *s, r,* draw the Line *s r q*, and describe the Ovolo equilaterally. (4) Make the Height of the Astragal, including its Fillet to the Neck of the Column, equal to half *n* C, of which give a 4th to the Fillet; make the Projection of the Fillet equal to its Height, and the Projection of the Astragal before the Fillet equal to its own Semidiameter, and the Height of the Fillet also as the Line DC, then will both the Astragals have equal Projections, and thus are all the Mouldings described. (5) Draw the Line BD, cutting the Line G *l* in G; from whence draw the Line GF parallel to AC, for the Cathetus of the Volute, cutting the Lines drawn

drawn from the Points *e* and L, in the Points 12, 13, which is the Height of the Eye of the Volute; biſect 12, 13 in T, the Center of the Eye; divide the Diameter of the Eye into 6 parts, on which deſcribe the Volute, as before done in the *Ionick* Volutes of *Vitruvius* and *Serlio.*

Plate CCL. *The* Compoſite *Entablature of the Ancients, according to* C. C. OSIO.

THE Height A Q being divided into 3 parts, give the lower 1 to the Architrave, the next 1 to the Freeze, and the upper 1 to the Cornice. *To divide the Architrave,* make the Tenia *n p* equal to two 9ths of *n t*, its whole Height, of which make the Regula *n o* one 5th; make the *Bead p q* equal to *n o*, and biſect *q t* in *r*; alſo make *r s* equal to one 5th of *r t*, then from the points *n*, *o*, *p*, *q*, *r*, *s*, *t*, draw Right Lines at Right Angles to the Line A Q, which will repreſent the Height of each Member in the Architrave. *To find their Projections,* make *b* M equal to *n q*, the Tenia with the Aſtragal, and make *d e* equal to *o p* the Height of the *Cima recta*, excluſive of its *Regula* and *Aſtragal,* make *k r* equal to *h p*, and draw *g k*; divide *k* R into 4 parts, and deſcribe the *Cima reverſa*, which completes the Architrave. *To divide the Mouldings of the Cornice,* (1) Biſect A D in G, and draw the Line 25 G of Length at Pleaſure; make A *c* equal to two 9ths of A D, of which make A *a* two 9ths, and *b c* one 4th of the Remainder; make *c e* equal to one 9th of *c* D, and *c n* equal to one 3d of *c* D; alſo make *n l* equal to one 4th of *e n*, make G *m* equal to one 4th of G D, of which F *m* is one 6th; alſo make the Height of the Ovolo *p* 27 equal to one 4th of G D; *laſtly,* make *s r* equal to one 6th of *w r*, and then from the Points A, *a*, *b*, *c*, *d*, *e*, *l*, *n*, G, F, *m*, *o*, *p*, draw Right Lines of Length at Pleaſure, and right angled to the Line AD. (2) Make A B equal to A D, then is A B the utmoſt Projection of the *Regula* of the *Cornice*; make D *y*, the Aſtragal of the Freeze, equal to one 18th of the whole Height of the Freeze; alſo make 27 D equal to D *y*, and draw the Line 28 *p*, then is *p* the Center of the Ovolo *q* 27; draw *q t* perpendicular to B D, and *s q* perpendicular to *q t*, then thro' the Point *s* draw the Line *r s w* parallel to A Q; from the Point 10 draw the Line 10 26 parallel and equal to *w s*; on *s*, with the Radius *s w*, deſcribe the Arch *y w u*, making the Arch *w u* equal to the Arch *y w*, and thro' the Point *u* draw the Line *z u* 1; make the Intervals *z m* and 1 2 each equal to half *w z*, and *m* 4 2 3 equal to *w z s* 1, and ſo in like manner divide all the other Dentils. The Point 12 terminates the Fillet to the lower *Cima reverſa*, and as the upper *Cima's* have their Projections equal to their Heights, complete them accordingly with the *Bead* and *Corona* under them, and thus is this Order completed, which finiſhes the Works of *Carlo Ceſare Oſio.*

Plate CCLI. *The* Compoſite Order *entire, by* J. MAU-CLERC, *not* VITRUVIUS, *as miſtakenly inſerted by the Engraver.*

I KNOW not by what Accident this Plate was placed here, it being the entire *Compoſite* Order of *J. Mau-clerc,* which ſhould have immediately preceded Plates CCLXXXIV. CCLXXXV. *&c.* wherein the particular parts of this Order are expreſſed at large; but as 'tis too late now to correct this Miſtake, I will here give the Manner of dividing the principal parts of this Order, and then refer you to its particular parts, as they are expreſſed in the Plates aforeſaid.

To proportion this entire Order to any given Height, divide the given Height into 81 parts, that is, into 16 parts and one 4th, accounting every 4 equal to 1; this done give the upper 2 with the odd one 4th, as alſo three 8ths of the third part unto the Height of the Entablature, and the lowermoſt 3 and two 3ds of the fourth unto the Height of the Pedeſtal, then the remaining Height being divided into 10, take 1 for the Diameter of the Column.

The

The Height of the Capital is 1 diam. and one 6th, and the Diminution of the Shaft is one 6th of its Diameter, as by its Divisions is demonstrated.

Plate CCLII. *The Base, Capital and Entablature of the* Composite Order, *in the Arch of* TITUS *at* Rome.

THIS Composition is one of the finest that is to be seen in the Remains of the Ancients; its Base is equal to its Semidiameter, which being divided into 11 parts, or the Diameter into 22, abate 1 on each Side, and take the 20 remaining for the Diameter of the Column at its Astragal, so that the Diminution of the Column is 11th of its Diameter, which is very inconsiderable. *The Height of the Capital* is equal to 1 diam. and a quarter. *To find the Height of the Architrave, Freeze and Cornice,* divide the Diameter of the Column at its Astragal into 8 parts, make the Height of the Architrave equal to 6 and three 5ths, the Height of the Freeze equal to 7, and the Height of the Cornice to the Diameter of the Column at its Base; the particular Members are determined by the Subdivisions of each part, which are very plain to Inspection. In Plate CCLV. is a perspective View of the parts of this Order very finely enriched, according to Mr. *Evelyn.*

Plate CCLIII. *The Geometrical Plan and Elevation of the Triumphal Arch of* TITUS *at* Rome.

THIS Plate represents the Plan and Elevation of the Arch of *Titus,* which was one of the finest Works of the Kind that the Ancients ever performed, and which will so appear, after having deliberately considered the Magnificency and Richness of its parts, which are expressed in the two following Plates. In the square Pannel Z was an Inscription, which not being material to our present Purpose is omitted: By the Plan underneath it is evident, that the Centers of the Plans of the Columns are in a Right Line, and therefore the Entablature must have been entire throughout, and not broken forwards, as is here represented in the Elevation, which I believe to be a Mistake of *Serlio*'s, from whom I had both Plan and Elevation.

Plate CCLIV. *The Members at large of the Arch of* TITUS *at* Rome.

THE several Capital Letters refer to the like Letters in the last Plate, wherein we see the Proportion of each Member and its Enrichments more distinctly, from whence some useful Hints may be taken for the ornamenting of other Works.

Plate CCLV. *A perspective View of the Base, Capital and Entablature (enriched) of the Arch of* TITUS *at* Rome; *as also a Geometrical Profile of the* Composite Order *in the Castle of* Lions *at* Verona, *by Mr.* EVELYN.

THE Entablature, *&c.* of the Arch of *Titus* having been already taken Notice of in Plate CCLII. I shall therefore proceed to my Remarks on the Profile of the Order in the Castle of *Lions* at *Verona,* whose Members are determined by Minutes, and their Projections accounted from the central Line. By the great Height of the Plinth, it seems as if this Order stood very high, on a Pedestal whose Cornice eclipsed a part of its Height. The Members placed on it are of the *Attick* Composition, making the total Height 37 min. and a half. The Column hath 8 min. Diminution, and the Height of its Capital is equal to 70 min. its Architrave 49 min. its Freeze 56 min. and its Cornice (which is very remarkable, in having the Dentils placed immediately

ately on the Freeze, without any *Cima, Ovolo* or *Cavetto* under them) is 49 min. which is equal to the Architrave.

Plates CCLVI. CCLVII. *The* Compofite Order, *by* A. PALLADIO.

THE Meafure by which this Mafter determines the parts of this Order is the Diameter of the Column divided into 60 min. as in his other Orders. Fig. A reprefents the Pedeftal and Bafe to the Column, of which the firft is good, but the laft, namely the Bafe to the Column, is horrid, he having indifcreetly introduced the fmall Aftragals together, which in the *Corinthian* Bafe he had wifely feparated; this fhews a Poverty of Invention in this Mafter, who is fo much celebrated by the Ignorant. Fig. B reprefents the Capital and Entablature, of which the firft is nothing more than the *Ionick Volutes, Ovolo* and *Aftragal,* crowned with the *Corinthian Abacus,* and thofe fet on the Vafe or Bell of the *Corinthian* Capital. The Architrave, which fhould have confifted of three *Fafcia's,* to have been elegant and airy, is here but in two, and thofe very clumfy, crowned (as it were) with a double Tenia, confifting of a *Bead,* a *Cima reverfa,* a *Cavetto,* and *Regula,* which together, altho' enriched, have a heavy, dull, *Tufcan* Countenance. The Freeze he has taken from the *Ionick,* and which is not amifs; but his Cornice is of little better Compofition than that of his Architrave, the Members being all very large and heavy, inftead of having a delicate Elegancy fuperior to that of the *Corinthian.* Fig. C reprefents his Intercolumnation in an Arcade, with Pedeftals, Fig. E his Impoft, which is very good, and Fig. D his Intercolumnations for Columns in *Colonades,* whofe Meafures are determined by Modules, or Diameters, and Parts; the Height of the Pedeftal is 3 diam. and 20 min. the Height of the Column 10 diam. whofe Bafe is equal to the Semidiameter, and its Diminution to 7 min. and a half, or one 8th of the Diameter; the Height of the Capital is 1 diam. and one 5th, the Architrave is 40 min. the Freeze 30 min. and Cornice 50 min.

		Diam.	Min.
The Height of the	Pedeftal and Column	13	20
	Column and Entablature	12	00
	Pedeftal, Column and Entablature	15	20

Plates CCLVIII. CCLIX. *The* Compofite Order *of* V. SCAMOZZI.

THE Fig. A reprefents the entire Order of this Mafter, and Fig. B the principal parts of its Pedeftal, Column and Entablature, wherein is a Beauty far preferable to that in *Palladio's.* The Members and their Enrichments of the Pedeftal are not amifs, and efpecially thofe of its Bafe. The Bafe to the Column is much better than that of *Palladio's,* and would have been the fame as his *Corinthian* Bafe had an Aftragal been placed under the upper Torus. The Capital differs very little from *Palladio's,* but the Architrave is very different, as being divided into three Fafcia's with a fingle Tenia, which looks much lighter and more genteel. As to the Freezes, I think that of *Palladio's* the moft proper for this Order, as being really *Ionick* in itfelf, but this Cornice would have been beautifully fine, had its lower Member, the *Cima reverfa,* been a *Cavetto,* that thereby all the Members of a Cornice might have been employed in the Compofition; but however, as it is, it is much preferable to that of *Palladio's.* The Module by which this Order is meafured, is the Diameter of the Column divided into 60 parts. The Height of the Pedeftal is 3 mod. the Column, with its Bafe and Capital, 9 mod. 45 min. of which the Height of the Bafe is equal to the Semidiameter of the Column, and its Capital to 1 mod. and one 6th; and *laftly,* the Entablature to 1 mod. and 57 min. of which the Architrave has 39 min. the Freeze 31 and one 4th, and the Cornice 46 and three 4ths. The Diminution of the Column is 8 min. and one 8th.

		Mod.	Min.
The Height of the	Pedeſtal and Column	12	45
	Column and Entablature	11	42
	Pedeſtal, Column and Entablature	14	42

The Figures D and H are two Frontiſpieces, that of D for a Window, the other H for a Door, whoſe Impoſts are repreſented by Fig. G.

Plate CCLX. Compoſite *Intercolumnations, by* V. SCAMOZZI.

THIS Plate exhibits four Deſigns, the upper two ſhewing the Intercolumnations for Portico's, as well with Pedeſtals as without, and the other two below, the Intercolumnations for Arcades, with and without Pedeſtals alſo; the Impoſt to be uſed with the Pedeſtals is that of G, and to that without Pedeſtals that marked C in the laſt Plate. The Meaſures of each are ſignified by Modules and Minutes.

Plates CCLXI. CCLXII. *The* Compoſite Order, *by* M. J. BAROZZIO *of* Vignola.

THE Meaſure, by which the Members of this Order are determined, is the Semidiameter of the Column divided into 18 parts. *To proportion this Order to any Height,* divide the given Height into 32 parts, give 7 to the Pedeſtal, 20 to the Column, (of which take 2 for its Diameter) and 5 to the Entablature. The Height of the Baſe to the Pedeſtal is 12 parts, and of its Cornice 14 parts. (This Pedeſtal, like the *Corinthian,* I think is much too high in its Die.) The Height of the Baſe to the Column is equal to the Semidiameter of the Column, and of its Capital to 2 mod. and 6 min. or one 3d. The Height of the Architrave, which is of the *clumſy Kind* with that of *Palladio*'s, is 1 mod. and a half; of the Freeze the ſame, and of the Cornice 2 mod. The Compoſition of the Cornice is very grand, as the Enrichment of the Freeze is very noble: But, upon the Whole, I think it more fit for the *Ionick* Order, than the *Compoſite*; for, in my humble Opinion, the Modillions of the *Corinthian* Order have more Buſineſs here with the *Ionick* Dentils, (as that this Order is compoſed of the *Ionick* and *Corinthian*) than the *Ionick* Dentils have in the *Corinthian* Order, where they are very miſtakenly introduced by many Maſters compriſed in this Work. The ſeveral Members of each part of this Order have their Heights and Projections determined by equal parts. In the middle part of this Plate is a geometrical Elevation of the Capital, directly oppoſite to an Angle, and below it, is its Plan in that View. The Figure next above the Elevation of the Capital is a ſmall part of the *Soffito of the Corona,* wherein the Ornament of its Angle, and Return of its Sides, are exhibited.

Plate CCLXIII. *A Compoſed Entablature, with ruſtick Quoins, by* M. J. BAROZZIO *of* Vignola.

AS this Entablature conſiſts of large and noble parts, which are adapted to the Strength of the Ruſticks, I think this may be very juſtly conſidered as an abſolute Order in itſelf, independent of all the others, which therefore may be called the *Ruſtick Order. To proportion this Order with its Ruſticks to any Height,* divide the given Height into 11 parts; give the upper 2 to the Entablature, and lower 9 to the Height of the Ruſtick. *To divide out the Ruſticks,* divide their Height into 23 parts, and each part into 13; then take 12 for the Height of each Ruſtick, and 1 for the ſquare Rabbit between. By dividing the Height into 23 Ruſticks, the lower and the upper one will be Stretchers, whoſe Lengths muſt be equal to twice their own Heights, and the Length of each heading Ruſtick muſt be equal to two 3ds of a Stretcher. *To divide the Entabla-*

Entablature into its Architrave, Freeze, and Cornice, divide its Height into 66 parts, of which give 18 to the Architrave, 20 to the Freeze, and 28 to the Cornice; whose Members subdivide according to the Figures affixed to each, signifying the Number of those parts, that they severally contain. Before I conclude my Discourse on this Order, I must beg Leave to observe, (1) That in its Architrave there is a simple Richness, altho' so very plain. (2) That its Freeze, by its being divided into Metops by the Cartouzes, that are placed there to support the *Cantalivers* (or carved Modillions of the Cornice) has a very grand and noble Aspect: And *lastly,* its magnificent *Corona* and *Cymatium* crown and compleat the Majesty of the Whole.

Plate CCLXIV. *A* Composite *Door in a rusticated Wall, by* M. J. BAROZZIO *of* Vignola.

THE Diameter, or Breadth of this Door is divided into 5 parts or Modules, and each Module into 18 parts, by which the Whole is proportioned according to the Number of such parts, as expressed by the Figures on each Member. The Height of the Rusticks is divided into 17 parts, and each part into 13, as before in the last Plate. The Section within-side is a Section of the *Architrave, Freeze, Cornice,* and *Cartouzes,* with the Measures of their parts.

Plate CCLXV. *A Door, by* M. ANGELO, *in* Capidoglio.

BY the *Ionick* Columns on each side, one would believe, that he intended this Door after that Order; but if we examine its Ornaments above the Architrave, (which are of a very low Taste) it is not easy to tell, to which of the Orders it may be applied, or he intended it: But however, if all that paltry Stuff above the Architrave, and the Breaking-off the Architrave under the Shield, be excluded, the Remainder is very grand and noble.

Plates CCLXVI. CCLXVII. *A* Composite *Frontispiece, near* St. George Belabro, *built in the Time of* LUCIUS SEPTIMUS SEVERUS, *by* S. SERLIO.

IN this Example, we see, that the Intercolumnation of the inner Columns is very great, being 9 diam. but as the Necessity of the Building did require it so, it could not be otherwise. The Pedestal under each pair of Pilasters, being continued without being broken, and made into two separate Pedestals, is much the most noble and grand Way; but the Continuation of the Mouldings between the Bases to the Pilasters is quite false, as also that of the Astragal under the Capitals. The great Table lying over the two middle Columns, whose Height is equal to the Architrave and Freeze, had an Inscription in it, which is omitted, as not being our present Business to relate. The two small Pannels at the End of the great Table are more for Ornament than Use; and the Fragments of the Architrave and Freeze at each End, over the two outer Columns, are for the Preservation of the Order, which would have been destroyed, had that great Table, or its End-Pannels, been continued quite thro'. Plate CCLXVII. represents the principal parts of this Edifice at large, with its Ornaments, which are very rich.

Plates CCLXVIII. CCLXIX. CCLXX. *The Triumphal Arch at the Gate* Dei Leoni *in* Verona, *by* S. SERLIO.

HOWEVER useful it may be in high Streets of Cities, where great Numbers of People are constantly passing and re-passing, to divide the Entrance into two

two Arches, as here is done, the one admitting a going in, and the other a coming out at the ſame Time; yet I think they are not, nor cannot be ſo grand and noble as when the Whole conſiſts but of one. The little Order, placed between the lower and the upper Order, is quite *Gothick* and ſcandalous; it may be, that from the Apertures between them, many Perſons of Diſtinction might ſtand there to ſee Proceſſions of divers Kinds, but yet that is not an Authority to have ſuch a Monkey Order placed there; for inſtead of it, a Balluſtrade would have done the ſame Thing, and been a proper Ornament in that Place; but indeed then the upper Order muſt have been ſet ſo far back as to have admitted of the Balluſtrade before it, and which might have been done with great Majeſty. Plates CCLXIX. CCLXX. repreſent the principal parts of this Arch at large, wherein the Capital Letters refer to their reſpective parts.

Plates CCLXXI. CCLXXII. *The Triumphal Arch of* L. S. SEVERUS, *by* S. SERLIO.

BY the Plan of this Arch we are ſhewn, that it was very magnificent, but as the Entablature is broken back over every Column, it's plain that thoſe Columns were uſeleſs, as having nothing conſiderable to ſupport, which is contrary to their Inſtitution; therefore to have made thoſe Columns uſeful, and Ornaments at the ſame Time, the Entablature ſhould have been continued entire, which would have given a Grandeur to the Whole, greater than Words can expreſs. The particular parts of this Arch are ſhewn at large in Plate CCLXXII. wherein F repreſents the Mouldings of the Baſe of the Pedeſtals, which is as noble as the Cornice to the Pedeſtal, under E the Baſe to the Column, is ſtrange. The Sub-plinth to the Baſe of the Column, marked E, is well conſidered, in caſe that the Cornice of the Pedeſtal is much above the Eye; for was the Plinth under the Torus to ſtand on the Pedeſtal, the Projection of its Cornice would totally eclipſe it. The Baſe to the Column is of the *Attick* Compoſition, the Aſtragal on the upper Torus only excepted, and is very good. It is ſomething very uncommon to ſee Modillions in an Impoſt, as are in C, which is the Impoſt to the middle Arch; but if we conſider, that at that Height there might have been a Floor within, whoſe Joiſts were laid out, to ſtrengthen the upper Members, they were therefore very proper. The Impoſt G, which belongs to the Side Arches, is a horrid Compoſition, but the Architrave, Freeze and Cornice, B, is very good: And here again is another Example of the *Corona*, finiſhing with a Fillet or *Regula*, without any *Cymatium* whatſoever.

Plates CCLXXIII. CCLXXIV. *The Triumphal Arch at* Benevento, *by* S. SERLIO.

BY the Plan of this Arch it is evident, that all the Centers of the Columns are in one Right Line, and therefore I am ſurpriſed that the Entablature was not made entire as the Pedeſtals are; 'tis true, that the bringing the Entablature and Parapet over the Arch, before the Sides, doth give ſome Majeſty to that part; but then to break over the two extream Columns, and bring them forward alſo, is very poor and trifling, not to be practiſed by any that would be eſteemed a Judge of Architecture. To have made the middle part truly grand, thoſe Columns ſhould have advanced quite clear of the Wall, with Pilaſters behind them to ſupport the returned Entablature on each Side. In Plate CCLXXIV. the ſeveral Members of this Arch are exhibited at large, of which the Entablature C, and the Baſe and Cornice to the Parapet A B, are very pretty Compoſitions.

Plate

Plate CCLXXV. *The Gallery at* Belvedere *by* BRAMANT.

I CANNOT tell what bewitched ſo many of the ancient Architects, to break the Entablatures over their Columns as here is done, in this, and many other of their Examples; ſince that the only Way to make all Buildings truely grand, is to avoid Abſurdities, and ſmall parts; for as the Architrave is the Baſis of the Entablature, it ought not to be weaken'd, by being broken into many parts, thereby having a regular Bearing in ſome parts, and not any in other parts, which is abſurd. The Gallery here repreſented would have been very grand, had not its Entablature been broken over every Pair of Columns, on which the Architrave has a regular Bearing; but the Architraves over the Arches have no Bearings at all, ſave that in the Wall over which they lye, and therefore are abſurd; as are alſo the little parts, into which the Entablature is broken. The principal Members of this Arch are exhibited at large in the lower part of this Plate.

Plates CCLXXVI. CCLXXVII. *The triumphal Arch of* CONSTANTINE, *by* S. SERLIO.

As the Columns of this Arch do advance clear of the Building, and have Pilaſters behind them, to have made this Entablature in one continued Piece, would have been ſurpriſingly grand and noble; but to break it over every Column is monſtrouſly ſhocking, and ſeems to intimate, that they were not Maſters ſufficient to carry its Architrave in Stone from one Column to the other. In Plate CCLXXVII. is exhibited the principal Members of this Arch at large, wherein are many fine Compoſitions, well worth our Conſideration.

Plates CCLXXVIII. CCLXXIX. *The* Compoſite Order, *by* A. PALLADIO, V. SCAMOZZI, M. J. BAROZZIO, *of* Vignola, *and* S. SERLIO, *by Mr.* EVELYN.

IN Complaiſance to many, who delight in Mr. *Evelyn*'s Method of deſcribing the Orders by Modules and Minutes, with their Projections accounted from the central Line, I have therefore, in theſe two Plates, repreſented the *Compoſite* Order according to the above Maſters in that Manner, wherein we may obſerve the Entablature of *Serlio*, whoſe Cornice is really *Tuſcan*, to be (beyond all Manner of Doubt or Diſpute) the very worſt Compoſition of Members that have been yet placed over the *Compoſite* Capital, with which they have no Kind of Connection, or Affinity of Parts, and is therefore unworthy of our Notice.

Plate CCLXXX. *The* Compoſite Order *entire, with the principal Parts of the Pedeſtal at large, by* S. LE CLERC.

THE Module, by which this Maſter proportions the parts of this Order, is the Semidiameter of the Column, divided into 30 min. *To proportion this entire Order to any Height,* divide the given Height into 30 mod. and 20 min. that is, divide the Whole into 91 parts, and each part will be equal to 20 min. and conſequently the Diameter of the Column is equal to 3 of thoſe parts.

THE Height of the Pedeſtal is equal to 6 mod. 15 min. not 16 min. as expreſſed in the Plate. The Height of the Column, including its Baſe and Capital, is 19 mod. and 50 min. (not 20 min. as expreſſed in the Plate) and the Height of the Entablature to 4 mod. and 15 min. The Height of the Baſe

 to

to the Pedeſtal is 34 min. and one half, and its Cornice to 16 min. The Height of the Baſe to the Column, is equal to its Semidiameter, and of its Capital, to 2 mod. and 10 min. The Diminution of the Shaft is 8 min. The Height of each Member is expreſſed by Minutes, and their Projections are accounted from the Upright of the Die, and of the Column.

THE Mouldings, that compoſe the Baſe and Cornice to the Pedeſtal, and the Baſe to the Column, are in general very noble, and worthy of Imitation. On the Right-hand of the lower part of the Plate is the Vaſe of the Capital, under which is its Plan; and on the Left of the following Plate are the ornamental parts of the Capital at large.

Plate CCLXXXI. Compoſite *Entablatures, with Impoſts, and the ornamental Parts of the Capital at large, by* S. LE CLERC.

THE Height of the Entablature being 4 mod. and 18 min. give 40 min. to the Architrave, 44 min. to the Freeze, and 54 to the Cornice. Both theſe Entablatures have the Uprights of their firſt Faſcia's of their Architraves of 30 min. or 1 mod. in Projection from the central Line, as being made for Pilaſters without Diminution. The Impoſts are both compoſed of the ſame Members, but differ in their Heights, the under Impoſt having 34 min. Altitude, and the upper but 30. The Members that compoſe the Entablatures are well choſen, and have a very good Effect. The Volute on the Right-hand is deſcribed by Method II. in Plate Z, after Plate CV. The ſeveral Leaves, *&c.* of the Capital are here ſhewn at large, to be oftentimes copied ſingly, that thereby the young Student may be well acquainted with each particularly, and with Eaſe and Delight repreſent them moſt exactly in Concert in their proper Places of the Capital.

Plate CCLXXXII. Compoſite *Entablatures, Impoſts and Intercolumnations, with the* Compoſite *on the* Ionick Order, *by* S. LE CLERC.

HERE are two other Entablatures repreſented by this Maſter, the one for a Column, where its Architrave has but 26 min. Projection; and the other for a Pilaſter, where it has 30 min. Projection; the laſt of which has a perpendicular Freeze, and the former a convex, or ſwelling Freeze. But the Members in both theſe Entablatures are of the ſame Kind with thoſe in the laſt Plate, and differ only in their Heights; for, as the Entablature of the laſt Plate conſiſted of 4 mod. and 18 min. theſe here are, one of 4 mod. and 10 min. and the other of 4 mod. and 12 min. in Height. Here are alſo three Impoſts, whoſe Members are the ſame as thoſe in the laſt Plate; but their Height are all various, and their Architraves are different; therefore their Choice is at Diſcretion, as the Nature of the Place, wherein they are to be uſed, doth require. This Plate doth alſo repreſent the *Compoſite* Order on the *Ionick*, where the Columns are placed in Pairs, and wherein the Intercolumnation of the *Compoſite* is regulated by that of the *Ionick*, becauſe the central Line of the upper Order muſt be exactly perpendicular over the central Line of the lower Order, as has been already obſerved. We have here alſo the Intercolumnations of this Maſter for this Order in Portico's, or Colonades, and underneath is an Arcade of ſingle Columns without Pedeſtals.

Plate CCLXXXIII. Compoſite *Arcades, by* S. LE CLERC.

THE uppermoſt Figure on the Left-ſide of this Plate is another Arcade without Pedeſtals, which is to be made with ſingle Columns, or Columns in Pairs; the other four Examples are all with Pedeſtals, and very grand Deſigns; and eſpecially thoſe crowned with the Balluſtrades, Statues, and Trophies of War. The Intercolumnations of each are expreſſed by Modules and Minutes.

Plate

Plate D, to follow Plate CCLXXXIII. Compoſite *Sofito's*, &c. *by* S. LE CLERC.

WE have here another Entablature of 4 mod. and 15 min. in Height, whoſe Architrave, projecting but 26 min. is therefore calculated for a Column. Here is alſo another Impoſt of 34 min. in Height, with a View of the Key-ſtone of the Arch, as well in Profile, as in Front, with its particular Meaſures of Height and Projecture. The Quadrant, number'd 1, 2, 3, 4, 5, 6, repreſents one 4th part of the Plan of the Baſe of the Shaft, divided into ſquare Flutes and Fillets, inſtead of circular Flutes. The two upper Figures repreſent the Plans of the Sofito's of the Cornice, and Manner of returning it, as well at an internal, as an external Angle.

Plate CCLXXXIV. *The* Compoſite *Pedeſtal by* J. MAU-CLERC.

THE principal parts of this Order being demonſtrated in Plate CCLI. I ſhall therefore proceed to the Diviſion of the parts of the Pedeſtal, whoſe Height being divided into 10 parts, give the upper 1 to the Height of the Cornice, and the lower 1 to the Height of the Baſe; then divide the Height of each into 7 parts, and ſubdivide them again, as on the Right-hand is expreſſed; the remaining 8 parts is the Height of the Die, whoſe Diameter is equal to half its Altitude.

Plate CCLXXXV. *Two Examples of* Compoſite *Entablatures, with the Capital, Baſe,* &c. *by* J. MAU-CLERC.

ALTHO' this Maſter has made choice of two very bad Compoſitions of Members for Freezes and Cornices to this Order, which he has here exhibited in the ſame Figure, yet his Architrave and Capital are pretty tolerable, and his Baſe to the Column is very good. The Height of the Baſe to the Column is equal to its Semidiameter, and the Diminution of the Shaft is one 6th of its Diameter. The Members of the Baſe are found by the Diviſions and Subdiviſions on its Left-hand, and the Projection of its Plinth is equal to one 4th part of the Diameter, and that of the Pedeſtal is the ſame before the Upright of the Die: Or otherwiſe, divide the Breadth of the Die into 6 parts, and give 1 on each Side to the Projection of the Plinth. By the three Circles over the Capital, to which the two upright Lines of the Shaft are *Tangents,* 'tis evident, that the Height of the Entablature is equal to three times the Diameter of the Column at its Aſtragal, and that its Architrave, Freeze and Cornice are equal to each other.

Plate CCLXXXVI. *A perſpective View of the* Compoſite *Capital, by* J. MAU-CLERC.

THIS Baſe and Capital is very different from thoſe in the laſt Plate, that Baſe being very good, and this monſtrouſly bad, here being thoſe wretched, little Aſtragals placed between the *great Toruſes,* of which I have often complained. The Leaves of the Capital are of the Parſley Kind; and indeed I think the whole Capital to be an extraordinary Compoſition.

Plates CCLXXXVII. CCLXXXVIII. *The aforeſaid* Compoſite *Entablatures at large, with their Enrichments, by* J. MAU-CLERC.

AS the Compoſition of the Members in the two upper parts of theſe Cornices

nices are not good, it may be a Matter of Surprize, why I exhibit them again here at large. To this I anſwer, That, altho' the Members themſelves are not well choſen for the Places they are employed in, yet their Ornaments are very grand and noble, and teach us how to enrich thoſe Members in a very grand Manner, in their proper Places, when required.

Plate CCLXXXIX. *The* Compoſite *Order by* C. PERAULT.

To proportion this Order to any Height, divide the given Height into 46 parts; give 10 to the Pedeſtal, 30 to the Column, including its Baſe and Capital, and 6 to the Entablature. Theſe parts this Maſter calls Modules, of which three are equal to the Diameter of the Column. *To divide the Pedeſtal into its Baſe, Die and Cornice,* divide the Height into 4 parts, of which give the lower 1 to the Height of its *Baſe,* and half the upper 1 to the Height of the *Cornice. To divide the Mouldings of the Baſe to the Pedeſtal,* divide its Height into 3 parts, of which give the lower 2 to the Height of the Plinth, and the upper 1 to its Members, which ſubdivide into 10, and give to each, as there exhibited. *To divide the Mouldings of the Cornice to the Pedeſtal,* divide its Height into 12 parts, and give to each, as there exhibited. *The Height of the Baſe of the Column* is equal to its Semidiameter, and its Height being divided into 4, give the lower 1 to the *Plinth*; the remaining 3 parts divided into 5 parts, give the upper 1 to the upper *Torus*; the remaining 4 divided into 3 parts, give the lower 1 to the lower Torus; the remaining 2 parts divided into 3 parts, give 1 to each of the Scotia's, with their Fillets, and the other 1 to the two Aſtragals. *The Height of the Cincture* is equal to two 3ds of the upper Torus. *To determine the Projecture of the Plinth to the Baſe of the Column,* divide the Diameter of the Column into 15 parts, and give 3 to each Side for the Projection of the Plinth. *To determine the Projection of the Baſe and Cornice of the Pedeſtal,* make *p o* equal to one 4th of the Diameter of the Column, or 4 parts, for the Projection of its Baſe, and *c a* to 4 parts and a half, for the Projection of the Cornice. The other Members are determined from thoſe equal parts, as by Inſpection is very plain.

THE Diminution of the Shaft is two 15ths of the Diameter, and the Height of the Capital 3 mod. and three 5ths, which being divided into 7, give the upper 3 to the Height of the Volutes and Abacus, and the lower 4 to the two Heights of Leaves; which being divided into 6 parts, and the others above into 8 parts, from thence all the Members and Leaves are determined. *To divide the Entablature into its Architrave, Freeze and Cornice,* divide its Height into 20 parts, give 6 to the Architrave, as many to the Freeze, and the upper 8 to the Cornice; then divide the Architrave into 18, and the Cornice into 10, and give to each Member, as Inſpection doth exhibit. *Laſtly,* The Projection of the Capital is equal to the Projection of the Plinth of the Baſe to the Column, wanting 1 part; and the Projections of the *Tenia* of the Architrave, and of the Cornice, are both equal to their own Heights. Thus much for this Maſter, who would have finiſhed his Orders tolerably well, had he not (*Frenchman*-like) introduced the ſmall Aſtragals in the Baſe of his Column, and crowded into the Tenia of the Architrave one Moulding too much, which make the firſt look little and trifling, and the other heavy and diſproportionate.

Plate A A, to follow Plate CCLXXXIX. *The* Compoſite *Order, by* I. JONES.

THIS Plate exhibits the uppermoſt Order in the Royal Chapel (commonly called the *Banquetting-houſe*) at *White-hall,* in which the moſt remarkable Thing is, that the Capital has but one Row of Leaves; there are likewiſe two Things in this Buildings, which, I cannot but think, are very great Abſurdities, notwithſtanding it was deſigned by ſo great a Maſter, and is, by many, eſteemed

efteemed a perfect Piece of Architecture: (1) The Pilafters are diminifhed, which has a very ill Effect at the Angle of the Building, making the Wall appear not to ftand upright upon its Bafis. (2) The Entablatures, both of this, and the lower Order, are broke back over every Column and Pilafter, the Abfurdity of which I have before fhewn, and therefore I fhall not enlarge upon it here. The parts of this Order are determined by Feet, Inches, and Parts, as are all the other Orders of this Mafter.

Plate B B, to follow Plate A A, after Plate CCLXXXIX. *The* Compofite *Order, by Sir* C. WREN.

THIS Example is taken from the Infide of St. *Swithin's* Church in *Cannon-ftreet*, which is one of the many, built by this Mafter after the Conflagration of the *City* in *1666*; the Members are determined by Feet, Inches, and Parts, as are his other Orders.

Plates CCXC. CCXCI. *The* Compofite *Order entire, with its Pedeftal and Capital at large, by Mr.* GIBBS.

To proportion this Order to any Height, Fig. I. divide the Height into 5 parts, and give the lower 1 to the Pedeftal; the other 4 parts divided into 6 parts, give the upper 1 to the Height of the Entablature, and the lower 5 to the Height of the Column, which divide into 10 parts, and take 1 for the Diameter of the Column, whofe Diminution is one 6th of the Diameter. *To divide the Pedeftal into its Bafe, Die and Cornice*, Fig. II. divide its Height into 4 parts, give the lower 1 and one 3d of the next to the Height of the *Bafe*, and half the upper 1 to the Height of the *Cornice*. *To divide the Members of the Bafe*, Fig. IV. Plates CCXCII. CCXCIII. divide its Height into 3 parts, give the lower 2 to the Height of the Plinth, and the upper 1 to its Mouldings, which divide into 4 parts, and fubdivide the 2d and upper 1 into 3 parts, and give to each Member, as there is exhibited. *To divide the Members of the Cornice*, divide the Height into 6 parts, which fubdivide, as expreffed, and determine each Member, as is exhibited. *The Projection of the Plinth to the Bafe* is equal to the Height of its Members, as alfo is the Projection of the Cornice, beyond the Plinth of the Bafe to the Column. The Height of the Bafe to the Column is equal to its Semidiameter, which being divided into 3 parts, as in Fig. III. Plates CCXCII. CCXCIII. give the lower 1 to the Plinth, whofe Projection is equal to one 6th part of the Diameter; the other 2 parts being each divided into 5 parts, give the lower 3 to the lower Torus, the upper 2 and a half to the upper Torus, and to the other Members, as Infpection will inform you. *The Height of the Capital*, Fig. III. Pl. CCXC. CCXCI. is 1 diam. and one 6th, which being divided into 7 parts, or 3 parts and a half, and the lower 2 being each fubdivided into 4 parts, from thence you fee, that the Heights of its Leaves, their Foldings, Volutes, and Abacus, are determined. Underneath the Upright of the Capital are Plans of one quarter part of a Column, and of a Pilafter, with the Projection of their Capitals; and under thefe are Views of the Volutes of the Capital, both at its Angle, and in Profile, wherein 'tis to be noted, that the Volute is the fame, as in the *Ionick* Capital.

Plates CCXCII. CCXCIII. *The* Compofite *Entablature, by Mr.* GIBBS.

THE Height and Projection of this Entablature is the fame as the *Corinthian*; and its Height being divided into 10 parts, give 3 to the Architrave, as many to the Freeze, including the Aftragal, (which is a part of the Freeze) and 4 to the Cornice. The Height of the Aftragal, with its Fillet, is equal

to one 16th of the Height of the Cornice, or one 4th of a fourth part, as in Fig. VI. the Cornice at large is expreſſed. The Height of the Cornice being ſubdivided into 16 parts, give to each Member as exhibited. Fig. VII. is the Architrave at large, whoſe Height divided into 4 parts, and ſubdivided, give to each Member its parts, as expreſſed. The Projection of the Cornice is divided into 4 parts, and thoſe ſubdivided again into 6 parts (as againſt the lower part of the Cornice at large is exhibited) from which Diviſions the ſeveral Members of the Cornice are determined. This Cornice is very plain, and eaſy to be delineated; 'tis taken from the *Ionick* Modillion Cornice, which differs from this only in the Kind of the Modillion. The Line A B, in Fig. VI. repreſents the central Line of the Column, and the Line CD, the upright Line over the diminiſhed part of the Column, from whence the Projection of the Cornice is accounted The Scale divided into 4 parts, and thoſe ſubdivided into 6 parts, for determining the Projections of the Members in the Cornice, is alſo the Scale by which the Modillions are proportioned; therefore make the Breadth of each Modillion equal to 5 parts of that Scale, which divide again in 4, and ſet off 1 on each ſide for the Projection of the Modillion's Ovolo, or Capping. Theſe being done, the Diſtance, from the central Line of one Modillion to the central Line of the next, will be equal to the Semidiameter of the Column preciſely. Fig. V. repreſents the Impoſt and Architrave to this Order, for the proportioning of which (as alſo the Impoſts of all the other Orders) take this

GENERAL RULE.

MAKE the Height of Impoſts to Arches equal to one 8th of their Opening; which divide into three parts, give the lower 1 to the Height of the Neck or Freeze of the Impoſt, and the upper 2 to the Mouldings, which divide as the perpendicular Scale directs. The Height of the Aſtragal, at the Bottom of the Freeze of the Impoſt is equal to one 6th of the Impoſts Height, which divide into 3, give 2 to the Aſtragal, and 1 to the Liſt. The Breadth of Pilaſters under Impoſts ſhould always be equal to the Semidiameter of the Column, againſt which they ſtand, and the Breadth of the arched Architrave ſtanding on the Impoſt, muſt always be equal thereto. In the *Tuſcan* and *Dorick*, divide the Breadth of the Architrave into 3 parts, and give one to the Projection of thoſe Impoſts; but in the *Ionick, Corinthian,* and *Compoſite*, divide the Architrave's Breadth into 12 parts, and make the Projection equal to 5 of thoſe parts. The Architrave of this, and of the other Orders of this Maſter, hath the Members divided by the horizontal Scales, which are ſo very plain and eaſy, as to be underſtood at the firſt Inſpection.

Plate CCXCIV. *Intercolumnations for Arcades and Colonades,* &c. *by Mr.* GIBBS.

THIS Plate repreſents the Intercolumnations of Columns in Arcades and *Periſyliums*, or Colonades, or Portico's; of which the uppermoſt Figure is an Arcade with Pedeſtals, the middle Figure an Arcade without Pedeſtals, and the lowermoſt the Manner of placing Columns, ſingle or in Pairs, in *Colonades, Galleries, Portico's,* &c. whoſe Meaſures are in general denoted by Diameters and Parts.

Plate CCXCV. Compoſite *Doors with* Exotick *Pedeſtals, by Mr.* GIBBS.

The Figures A and B repreſent unto us three Deſigns for Frontiſpieces to Doors, and every one very good: That of A is a ſquare-headed Door, to be made either with three quarter Columns, or with Pilaſters only, as in its Plan

is

is exhibited. The Figure marked B may be finiſhed either with a Pediment or Balluſtrade, and therefore it may be underſtood as two Deſigns, which, as Figure A may be executed either with three quarter Columns, or Pilaſters only, as may be alſo ſeen by the Plan; or inſtead of Pilaſters only, they may have inſular Columns placed before the Pilaſters, which laſt is much the moſt grand Manner.

Figures C, D, Exotick *Pedeſtals.*

By Exotick Pedeſtals, we are not to underſtand Pedeſtals natural to another Country, and preſerved here by an artful Imitation of the Clime, as Gardeners do, to preſerve and continue the Growth of Plants brought from foreign parts, which they call *Exotick Plants*; but, ſays he, *I mean they are ſuch as have their Mouldings otherwiſe formed*, and adorned, than the regular Pedeſtals that belong to each Order, which are uſed generally for ſupporting of Statues or Vaſes in Gardens, *&c.* not but thoſe Ornaments may be ſupported by regular Pedeſtals. If we obſerve the Mouldings of the Cornices and Baſes to theſe Pedeſtals, we find, 1ſt, That the Cornice on the Right is compoſed of a *Regula*, a *Plat-band*, or *Faſcia*, with an *Ovolo* and a *Cavetto* under it; and the Cornice on the Left, we ſee, is compoſed of a *Regula* and *Plat-band*, or *Faſcia*, with a *Cima recta*, and *Cavetto* under it. 2dly, The Baſe on the Right-hand is compoſed of a *Cavetto*, an *Aſtragal*, a *Cima recta* inverſed, and a Plinth; and that on the Left of a *Cavetto*, a *Cima recta* inverſed, a *Torus*, and a *Plinth*; all which are Members *not otherwiſe formed*, as this Maſter (abſurdly) ſays they are, than the regular Pedeſtals; but are only differently compoſed, with the ſame Forms, as in the regular Pedeſtals of the Orders; nor are the Enrichments new; for in many of the Maſters aſſembled in this Work, we find the ſame Members, as here ſhewn in theſe Pedeſtals, enriched with the ſame Ornaments; and indeed, 'tis my Opinion, that from thoſe Maſters theſe Ornaments have been taken, and given us here as Rarities of *Northern* Growth. The Height of theſe Pedeſtals, and Manner of dividing them into their Baſe, *Dado*, or Die, and Cornice, this Maſter has forgot to ſpeak of, ſo that I am under a Neceſſity of eſtabliſhing

A GENERAL RULE for dividing an Exotick Pedeſtal into its Baſe, Die, and Cornice.

Divide the given Height into 9 parts, give 3 to the Baſe, 4 to the Die, and 2 to the Cornice; make the Breadth of the *Die* equal to its Height, and every Member of common Projection. *To divide the Baſes and Cornices into their Mouldings*, divide the Height of the Baſe into 9, and the Cornice into 6 parts, which ſubdivide again, and give to each Member ſuch parts as are exhibited in each. Thus much by Leave of this Maſter, until he aſſigns a new and better Proportion, than I have done, for completing theſe Kinds of Pedeſtals.

Plate CCXCVI. *A geometrical Elevation, Sofito, and Profile of the* Corinthian *Modillion, by Mr.* Gibbs.

To deſcribe the ſpiral Liſt of the Volutes to this Modillion, (1) Divide its Height into 8 parts, and from the Angle 7, ſet ſeven of thoſe parts towards the Left- hand, and then proceed to deſcribe the Volute, as for the *Ionick* Capital. (2) Divide the Perpendicular, that limits the Projection of the ſmall Volute, into the ſame Number of parts, and equal to thoſe, that limit the great Volute on the Right. (3) Divide the upper 4 parts each into 2 parts, and let theſe 4 parts be conſidered as 8 parts; this done, ſet off 7 of theſe 8 parts, from the ſaid Perpendicular Line, towards the Right-hand, on the lower

er Line of the *Cima reverſa*, from whence draw a Line parallel to the Perpendicular, to bound the Right-hand Side of the Volute; then will the Height of this Volute be equal to 8, and its Breadth to 7 parts, which is juſt the ſame Proportion, as the great Volute hath; and by the ſame Rule deſcribe this Volute alſo. Now, as the ſmall Volute ends at the Point F, and the great Volute at the Point L, the next Thing is, How to join thoſe two Volutes, ſo that their Arches may meet each other at Right Angles: To effect this, draw the Line F L, which biſect in D; divide F D and D L into two equal parts by the two Perdendiculars, E H and B I, which ſaid perpendicular Lines continue, until they meet the Cathetus of both Volutes, which are the two Centers, on which deſcribe the Arch F D and D L, which will join together the two Volutes, as required. *Note*, the Out-line of the Liſt is deſcribed on the ſame Centers, it being concentrick to the firſt. *Note alſo*, that the dotted Curve is the true Curve; the other full-lin'd is the Curve of this Maſter, which, not meeting the two Volutes at Right Angles, is therefore falſe, and his Method of deſcribing it rejected.

Plate CCXCVII. *Three Entablatures for Doors, Windows, or Niches, by Mr.* GIBBS.

THESE Entablatures are of three Kinds, *viz.* Fig. III. of *Tuſcan*, Fig. II. of *Dorick*, and Fig. I. of *Ionick*, and which are in general very good. *To proportion theſe Entablatures to the Height of any* Window, Door, *or* Nich, divide the Height into 4 parts for the *Tuſcan* and *Dorick*, and into 5 for the *Ionick*: Make the Height of the Entablature equal to 1 of thoſe parts, which divide into their Architraves, Freezes, and Cornices, by firſt dividing the Height into 3 parts, of which the lower 1 is the Architrave, three 4ths of the next 1 is the Freeze, and the remaining 1 and one 4th the Cornice; ſubdivide theſe again, that is, the Architraves each into 4 parts, and the Cornices into 6, 5, and 7 parts, which Inſpection doth demonſtrate. I here muſt obſerve, that I think the ſwelling Freeze to Figure II. whoſe Cornice is a *Dorick* Compoſition, ſhould have been upright, and the ſwelling Freeze given to Figure I. which is of *Ionick* Compoſition, and therefore are more properly together.

Plate CCXCVIII. *Profiles of Block Cornices, by Mr.* GIBBS.

THE Manner of proportioning theſe Kinds of Cornices to Buildings, being already declared in Plate XLV. I ſhall therefore only add, that theſe Profiles are here given for further Examples, not only to ſhew their various Compoſitions, but how this Maſter perſiſts in his erroneous Method of placing his Ruſticks under them, which ſhould have been in the Places of the dotted Ruſticks, as I have before obſerved. Fig. G H is an Architrave, Freeze and Cornice, for a *Door, Window,* or *Nich,* by *Palladio,* whoſe Heights are thus found divide the Height of the Entablature into 25 parts, give 8 to the Architrave 7 to the Freeze, and 10 to the Cornice.

Plate CCXCIX. *Three Entablatures for Doors, Windows, or Niches, by* A. PALLADIO.

THESE Entablatures have each a ſwelling Freeze, but their Cornices and Architraves have their Differences, as thoſe of Mr. *Gibbs*, and therefore I cannot think, that the ſame kind of Freeze is proper to all of them. *To find the Heights of the two upper Architraves, Freezes, and Cornices,* divide the given Height into 12 parts; give 4 to the Architrave, 3 to the Freeze, and 5 to the Cornice, in each Example: But, *to find the Heights of the Architrave, Freeze,*

Freeze and Cornice, in the loweſt Example FE, divide the given Height into 85 parts; give 32 to the Architrave, 13 to the Freeze, and 40 to the Cornice, whoſe Members divide as the Subdiviſions expreſs.

Plate CCC. *Mouldings for ſmall Pannels, by Mr.* GIBBS.

HERE are five Varieties of Mouldings repreſented, of which the firſt is a ſmall *Ovolo*, over a *Cavetto*, on an *Aſtragal*; the ſecond, a *Cavetto*, over a *Cima reverſa*, on an *Aſtragal*; the third, a *Cima reverſa* only on an *Aſtragal*; the fourth, a *Cima recta* on a *Cavetto*; and the laſt, an *Ovolo* only on an *Aſtragal*, and that on a *Cavetto*. Theſe Mouldings are divided in their Heights by the perpendicular Diviſions on the Right-hand Side, and their Projections by the horizontal Diviſions on the upper part of each: They are in general very good, and their Ornaments are well conſidered and very rich.

Plate CCCI. *Large Mouldings for Pannels or Picture Frames, by Mr.* GIBBS.

THESE Mouldings are alſo very rich and well proportioned, and wherein is a good Variety; the upper one conſiſts of an Ovolo and Cavetto, the ſecond of a *Cima reverſa* and an Aſtragal, and the lower of an Ovolo and ſmall *Cavetto* over the Freeze. The Freeze of the upper is enriched with a plain Fret, that of the Middle with a *Vitruvian* Scroll, (but not the very beſt that I have ſeen) and the lower with circular Laceings and Roſes: The lower or inward Mouldings are alſo different, and variouſly enriched with proper Ornaments, which have a noble Effect. The perpendicular Scales, denote the parts by which their Heights are determined, and the horizontal Scales, which are each equal to one 3d of their Heights, their Projectures.

Plate CCCII. *The* Spaniſh Order *entire, by* S. LE CLERC.

As this, and the *French* Order which follows, are no other than compoſed Orders, I have therefore placed them to ſucceed the *Compoſite* Orders of the preceding Maſters. The great Difference of this Order from other Maſters, conſiſts chiefly in its Capital and Ornaments of the Freeze, which they enrich with the terreſtrial Globe, embraced with *Cornucopia's*, alluding to the many parts of the Earth ſubject to them, and which, 'tis ſaid, are ſo numerous, ſo large, and ſo ſituated, that the Sun is always ſhining upon ſome one or more of their Dominions. The Capital is of the ſame Proportions as the *Corinthian*, and its Volutes alſo; but the Leaves are of another Kind, charged with a Kind of Husks, which have no diſagreeable Effect. The Module, by which the parts of this Order are determined, is the Semidiameter of the Baſe divided into 30 min. *To proportion this Order*, divide the given Heights into 30 mod. or parts, of which, give 6 mod. and 20 min. to the Pedeſtal, 19 mod. and 25 min. to the Column, including its Baſe and Capital, and 4 mod. and 15 min. to the Entablature. *To divide the Pedeſtal into its Baſe, Die, and Cornice*, give 35 min. to the Baſe, 16 to the Cornice, and the Remainder to the *Dado* or *Die*. The Height of the Baſe is equal to the Semidiater of the Column, and the Capital to 2 mod. and 10 min. and ſometimes to 2 mod. and 15 min. as the Capital at the Bottom of this Plate on the Right-hand is; where the Heights of the Husks, Leaves, Volutes, and Abacus, are each ſignified by Minutes. The Heights and Projectures of the ſeveral Members in the Baſe and Cornice of the Pedeſtal, and Baſe and Capital of the Column, and of its Entablature, are determined by Minutes, as before in the other Orders.

Plate CCCIII. *Five Entablatures of the* Spanish Order, *with its Imposts, by* S. LE CLERC.

THE Entablatures of this Plate are not of the worst Compositions, and therefore I recommend them to the Consideration of those who delight in new Inventions.

Plates CCCIV. CCCV. *Intercolumnations of the* Spanish Order, *with the Sofito of its Cornice; also the* Corinthian Order *on the* Spanish, *the* Spanish *on the* Roman *or* Composite, *and the* Corinthian *on the* Spanish *and* Roman, *by* S. LE CLERC.

IN Plate CCCIV. we have five Examples of Intercolumnations, of which the first are Intercolumnations proper for Portico's and Colonades; the next two for Arcades without Pedestals, and the lower two for Arcades with Pedestals, and those either with Columns in Pairs, or single Columns. The Measures of every Example are Modules and Minutes. The several Figures, and equal Divisions in the Entablature of every Example, denote the Number and central Lines of each Modillion, between every two Columns in each Intercolumnation. On the Left-hand Side is a Plan of the Entablature, exhibiting the Manner of placing the Modillions, and returning the Sofito, as well at an external, as an internal Angle. These being the several Intercolumnations of this Order, I shall now proceed to Plate CCCV. wherein we have three Examples of placing one or more Orders over another; of which the first is the *Corinthian* upon the *Spanish*, and wherein he is obliged to set the *Corinthian* on a Plinth, because the Height of the Windows cannot admit of a Pedestal, whose Cornice would be too high for their lower parts. It's to be here observed, that this Master pays the greatest Respect to the *Corinthian* Order, by placing it above, as being (as it really is) the most noble and elegant of all the Orders that have been yet, or may be invented. In his second Example he prefers the *Spanish* above the *Composite*, and indeed I think very justly; as that the *Spanish* Capital is not much unlike the *Corinthian*, and much more light and airy than the heavy *Composite*; and indeed, had Sir *Christopher Wren* at *St. Paul's*, placed his *Composite* Order in the first Story of that Building, it would have been much more agreeable to true Architecture, and to his Reputation also. On the Right-hand, at the Bottom, is his third Example, where he has placed the *Corinthian* triumphant over the *Spanish* and *Composite*, and which being seen together in one Front, and well executed, must appear very rich and magnificent.

Plates CCCVI. CCCVII. *The* French Order, *by* S. LE CLERC.

IN the first of these Plates we have this Order entire, with the Pedestal at large, and two Varieties of Capitals very prettily composed, and its Entablature with a very rich and elegant Composition. This Order is measured by Modules and Minutes, as the *Spanish* and other Orders are. *To proportion this Order* is a Work of some Trouble; as that its total Height is equal to 31 mod. and 12 min. which must be reduced into Minutes, which are equal to 942. Now suppose the given Height be 20 Feet, we must reduce them into Inches, which are equal to 240, and then say,

As 942, the Minutes contained in the whole Order,
Is to 240, the Inches contained in the whole Height,
So is 30, the Minutes in 1 Module,
To 7 Inches $\frac{606}{942}$ which is something more than 7 Inches and $\frac{3}{5}$.

The

The Module being thus obtained, and being divided into 30 min. give 6 mod. 22 min. to the Height of the Pedeſtal, 20 mod. 5 min. to the Height of the Column, including its Baſe and Capital, and 4 mod. 15 min. to the Height of the Entablature.

To divide the Pedeſtal into its Baſe, Die and Cornice.

GIVE 36 min. to the Baſe, 27 to the Cornice, and the Remainder to the Die. The Height of the Baſe to the Column is equal to its Semidiameter, and the Height of the Capital to 1 Diameter and one 6th. The next Part of this Order is its Entablature, of which we have two Examples in Plate CCCVII. which are of different Heights, the one on the Right-hand being 4 mod. 15 min. and the other 4 mod. and 10 min. in Height, of which the firſt has 39 min. to its Architrave, 42 to its Freeze, and 54 to its Cornice, and the latter hath 38 to its Architrave, 40 to its Freeze, and 52 to its Cornice. The Projections are alſo different, the one having 52 and the other 55 min. The Diminution of the Shaft is 8 min. We have alſo two Kinds of Imposts and Architraves, with a direct or front View, and Profile or ſide View of the Conſole, or Key-ſtone, enriched in a very elegant Manner, which, tho' not proper to be ſtrictly copied, may be a good Help to Invention.

Plate CCCVIII. *The* Groteſque Order *for Entrances in Grotto's, Hermitages,* &c. *of my own Invention.*

BEFORE a Frontiſpiece of this Kind can be made, the Diameter of the Door muſt be given, which divide into 4 parts, or one half into 2 parts, as in this Example. This being done, (1) draw a central Line and a Baſe Line at Right Angles to it; on this Baſe Line ſet on each Side the central Line the given Breadth, or Diameter of the Entrance, and divide each half into two parts. (2) Set on the Baſe Line one 4th part of the Diameter of the Entrance; from the Sides of the Entrance outwards both Ways, as to *l i*, and from thoſe Points draw Right Lines, as *l m* (on the Right-hand, and the like on the Left) parallel to the central Line, which Lines are the central Lines of the two inward Columns. (3) Make *l i* equal to half the Diameter of the Entrance, and draw *i k* parallel to *m l*, for the central Line of the outer Column. Perform the like on the other Side, and then will all the central Lines of the four Columns be deſcribed. (4) The Diameter of the Entrance being divided into 4 parts, take 2 parts and a half, and ſet it up on the central Line of the Entrance, 5 Times as to Z, or rather on one Side, as on the Right-hand is done, where the outward Scale, which is equal to the whole Height, is divided into 5 parts. (5) Give half the lower 1 to the Height of the Sub-plinth, the upper 1 to the Height of the Pediment, above the Entablature, and the remaining 3 and a half to the Height of the Column and Entablature, which divide into 5 parts, (as in the ſecond Scale is done) give the upper 1 to the Entablature, and the lower 4 to the Column. The Height of the Entablature being divided into 3 parts, give 1 to the Architrave, 1 to the Freeze, and 1 to the Cornice. (6) Divide the lower 1 of the outer Scale into 5 parts, and make the Height of the Baſe *s t*, and Capital 28 27 of the Columns, equal to 1 of thoſe parts. (7) Divide the Height of the Shaft into 7 parts, and give the 2d, 4th and 6th to the Ruſticks. The Height of the Cincture is one 6th of the firſt part of the Column, contained between its Baſe and the loweſt Ruſtick, as likewiſe is the Fillet under the Capital. The Height of the principal parts being thus determined, and the Diameter of the Columns being equal to one 7th of their Height, and Diminution to one 4th of their Diameter, complete their Shafts, giving Projections to the Cinctures and Fillets equal to their own Heights; make the Projections of the Baſes and Capitals, from the Cinctures and Fillets, equal to the ſame. The Projection of the Sub-plinth *t v* is equal to the Diagonal Diſtance *y z*, or *q s*, and the Projections of the Ruſticks are

are terminated by Lines drawn from the Cinctures to the Fillets, parallel to the Shafts of the Columns. *To determine the Impoſt,* divide O P, the ſecond Ruſtick, into 4 parts, and give the middle 2 to the Height of the Impoſt. The Projection of the Impoſt is equal to one 4th of its Height. The Center of the Arch being placed on the Line F O, the upper part of the Ruſtick continued, the Diſtance F M is a Right Line, and which is ſo made to elevate the Arch; ſo that the Projection of the Impoſt may not take off or eclipſe a part of it, and cauſe it to appear leſs than a Semicircle, which it ought not to do.

To proportion the Key-ſtone to the Arch.

DIVIDE G F into 7 parts, and give 1 to one half of the Key-ſtone, which I divide into 2, and give 1 for the Deſcent or Drop of the Key-ſtone, below the Sofito of the Arch. The next Work is to proportion the Architrave and Freeze, ſo that from a certain given Point of View they ſhall appear of equal Height. To do this, (1) Let the Face of the Architrave 5 29 be drawn, whoſe Projection from the perpendicular Line of the Column is equal to that of the Fillet. (2) Draw Right Lines from the Top of the Freeze, and Bottom of the Architrave unto the given Point, and the Angle made there, by the meeting of thoſe two Lines, being divided into 2 equal parts by a third Line, drawn from the Angle until it meet the Architrave, will cut the Architrave and Freeze into 2 Parts, as at the Points 3 and 5, then will 5 29 be the Height of the Architrave, and 3 8 the Height of the Freeze, which will appear equal to one another, becauſe they are ſeen under equal Angles, and the Part of the Freeze 3 4 will be hid, and have no more Effect on the Eye than if it was not there; therefore 'tis evident, that to make the Freeze appear equal to the Architrave at a given Point, the Height of the Freeze muſt be greater than the Architrave, as much as is equal to the Height 3 4. It is for want of knowing this Rule that the Metops in the *Dorick* Order do appear to be Parallelograms of leſs Height than Extent, inſtead of Geometrical Squares, as they ought to do; and the ſame is alſo to be ſeen in *Attick* Windows, which though made preciſely ſquare do not appear ſo, becauſe the Projection of the *Tenia* of the Architrave in the firſt, and of the Window-ſtools in the laſt, do eclipſe a part of their Height in every Situation and View, when the Height of the Eye is below the horizontal Lines of their Heights: Therefore, before a Work is erected, a Conſideration ſhould be firſt made, of the moſt common Place at which the Building will be viewed, and then to give to every part, next above every projecting Member above the Eye, ſuch Allowances in Height as ſhall preſerve the Symetry and true Proportion of the Whole, in the very ſame Manner as if the Eye was placed at Right Angles againſt every of its parts at the ſame Time. The next Work to be done is to give the *Corona* its Projection, which is equal to its Height; and its Height being divided into 4 parts give 1 to its *Regula*. The *Ovolo* on the *Corona*, I am ſatisfied, was never uſed above the *Corona*, or any other Member in its ſtead, by the Ancients (and of whom I have already produced ſome ſuch of their Examples in the preceding Plates) indeed, where Pediments are uſed, then there ſeems to be a Neceſſity for a greater Projection to keep off the Weather, becauſe Pediments are never to be uſed but over Doors, Windows, or other ſuch Apertures, which require to be ſheltered more from Rains than any other parts of the Outſides of Buildings. *The Height of the Ovolo* is equal to one 5th of the Pediment's Height or Pitch, and as its Center is perpendicular over the Extreme of the *Corona*, and being a *Quadrant*, its Projection is therefore equal to its Height. As it is ſuppoſed, in this Deſign, that the two middle Columns which carry the Pediment, come forward from the Line of the Columns, at the Extremes, 1 diam. and a half clear of the Pilaſters behind them; therefore the Entablature is broke back from the Outſide of the middle Column, and the ſame Profile completed up to T, as is over the extreme Column up to W; *laſtly*, draw the Lines Z T, A V, *&c.* and complete the Pediment; alſo divide the Diſtance

Diſtance E C into 12 parts, and make C D equal to 1 of thoſe parts, then give 2 of thoſe parts to each Truſs; and 2 to each Interval, and thus will the whole Frontiſpiece be completed.

N. B. PERHAPS it may be asked; why I have placed an *Ovolo* to crown this Entablature, when I have declared ſo much againſt it in the *Tuſcan* Order? To this I anſwer, That whereas thoſe Orders are ſuppoſed to be worked very accurately in Stone, the ſooner their upper parts are decayed by Time, the leſs beautiful they appear; and their bringing the Water down upon the Face of the *Corona* makes them uſeleſs, becauſe the *Corona* is as well able to do that Work of itſelf, as when the *Ovolo* is on it: But as this Order is calculated for Entrances into *Grotto's, Subterranean Paſſages, Hermitages,* &c. the more and ſooner its parts are fractured and defaced, the more it is agreeable to thoſe Works; and its introducing the Rain Water upon the Face of the *Corona*, thereby cauſing it to become of a green Colour, is rather a Beauty than a Defect; for the more ruinous and antient thoſe Buildings ſeem to be, the nearer they approach the Taſte of the preſent Age.

Plates CCCIX. CCCX. *The* Engliſh Order *of my own Compoſition, geometrically divided by Mr.* R. WEST.

I MAKE no doubt but that many will ſay, I have given myſelf ſome unneceſſary Trouble in the compoſing of this Order, ſince that there are already ſo great a Variety among the ſeveral Maſters here aſſembled: Indeed I muſt own, that here is the greateſt Collection that hath been yet (or perhaps ever may be) ſeen in one Work: But then, to the immortal Shame of ourſelves, they are all either the Inventions of Foreigners, or Monkey Imitations of them; nor has any one *Engliſhman*, that I know of, ever yet attempted to compoſe an Order in Honour to his Country, as the *Greeks, Latins, Romans, French* and *Spaniards* have done, and it is therefore that I have taken the Liberty to annex this Order to the foregoing Collection, which every one is to receive or reject at his Pleaſure, and whoſe parts are divided as follows: Let A H (in the uppermoſt Figure of Plate CCCIX.) repreſent the given Height of an entire Order. *To find the Height of its Pedeſtal, Column and Entablature,* divide A H in the Middle, and thereon, with a Radius of half its Length, deſcribe a Circle, as P M A I L, *&c.* whoſe Circumference divide into 12 equal parts, as at I L K Q H, *&c.* which is eaſily done, thus; ſet one Foot of the Compaſſes in the Point A, and with the ſame Opening that turned the Circle, mark the Points P I; in like manner ſet one Foot in H, and mark O K, which divides the Circle into 6 parts, biſect each of theſe, and the Whole is divided into 12, as required. Draw the Right Line M I, cutting A H in B, then is A B the Height of the Entablature; alſo draw the Right Line N L, cutting the Line A H in D, then is D H the Height of the Pedeſtal, and B D the Height of the Column, including its Baſe and Capital. *To divide the Height of the Pedeſtal into its Baſe, Die and Cornice,* divide D H in the Middle, and thereon, with a Radius equal to half its Height, deſcribe a Circle as *q* D *p* H, *&c.* whoſe Circumference divide into 12 parts, as before, at the Points *o, p, u, w,* H, *&c.* draw the Right Line *r p*, and it will cut D H in E, then is E D the Height of the Cornice to the Pedeſtal; alſo draw the Right Line *t u*, cutting D H in F, then is H F the Height of the Baſe to the Pedeſtal; draw the Right Lines *s w* and *p* H, interſecting each other in the Point G, from whence draw a Right Line, to cut the Line F H at Right Angles, then will the lower Segment of F H be the Height of the Plinth, and the upper the Height of its Mouldings.

To divide the Height of the Column into its Baſe, Shaft and Capital,

(1) DIVIDE B D in the Middle, and thereon, with a Radius equal to half its Height, deſcribe a Circle as Y W T B S, *&c.* which divide into 12 equal parts,

parts, as before, draw the Right Lines Y D and Z *k* (to the firft part on the Left of D) interfecting in *k*; from *k* draw *k i* at Right Angles to B D, bifect *i* D in *m*, then is *m* D the Height of the Bafe, and *i* D equal to the Diameter of the Column. (2) Draw the Right Line W R, cutting B D in V; bifect B V in C, then is B C the Height of the Capital. The Diminution of the Shaft is one 6th of its Bafe.

To divide the Entablature into its Architrave, Freeze and Cornice,

DIVIDE A B in the Middle, and thereon, with a Radius equal to half its Height, defcribe a Circle; divide the Circumference into 12 equal parts, as before; (the Points are not all marked in the Figure, as not being all wanted) draw the Right Lines *f a* and *b d*, cutting each other in *c*, from *c* draw a Right Line to A B, and at Right Angles thereto, then will the Diftance from that Point to A be the Height of the Cornice; draw the Right Lines *f d* and *a* B, interfecting each other in *e*, from whence draw a Right Line at Right Angles thereto, then will the Diftance from that Point to B be the Height of the Architrave, and the other *Intermediate* between that and the Cornice is the Height of the Freeze.

AS I have thus fhewn the Manner of dividing out the principal parts of this Order, I fhall now proceed to the Divifion of its particular Members; and *firft*, thofe in the Bafe of the Pedeftal, which are reprefented at large at the Bottom of this Plate. *To divide the Mouldings of the Bafe to the Pedeftal,* make *r s* equal to one 3d of the Height, and draw the Line *s* 10 1 both ways at Pleafure, and in any part thereof, as at 1, with the Radius *r s*, defcribe a Quadrant, as 2 10, and on the Point 10, with the fame Radius, the Quadrant 4 1, interfecting the former in 3; then on the Point 3 take the neareft Diftance to the Line *s* 10 1, as to *g*, and with that Radius interfect the two Quadrants on each Side, and through thofe Interfections draw the Fillet to the Cavetto.

Note, This Method of taking out a Fillet from a given Breadth, as from *r s*, will be often done in the dividing of the other Members; and as I fhall not again explain the Manner of doing it, you muft well underftand it (which is very eafy to do) before you proceed further, and which being done on any Point in the Line P 13, as at 13, with the Radius *s u*, defcribe a Quadrant, as 1 12, and on 12, with the fame Radius, defcribe the Arch 13 11, then thro' the Point 11 draw the lower part of the Aftragal. The Depth of the *Cima recta* inverfed is half the Remainder, and its Fillet is one 4th of the other half, the other three 4ths is the Torus. The Projection of the Plinth is equal to the Height of the Mouldings, and the other Members finifh in common courfe. *Secondly, To divide the Mouldings in the Cornice of the Pedeftal,* with the Radius A B defcribe the Circle D A G, *&c.* and on the Points A and C, with the fame Radius, defcribe the Arches F B H and D B G, interfecting the Circle in D G F H; through D G draw the Head of the *Plat-band* or *Fafcia,* through B draw the Head of the Ovolo, and through F H draw the Head of the *Cavetto,* then will thefe Members divide the Height into 4 equal parts; in the lower fourth part make a geometrical Square, as *n l p q*, draw the Diagonals *n q* and *l p*, then take half the Diagonal, as *l o*, and fet it down towards *q*, which is the Height of the Cavetto, the Remainder is the Aftragal. Out of the 3 upper parts take the 3 Fillets, as taught before, and the Remainder will be the *Ovolo*, the *Fafcia*, and the *Cima reverfa*, with its Regula included, which *Regula* is one 4th part thereof. As the Projection of the Mouldings of both the Bafe and Cornice depend on the Diameter of the Die of the Pedeftal, and as the Die is regulated by the Projection of the Bafe to the Column, we muft therefore, in the next Place, proceed to the Divifion of the Mouldings of the Bafe and their Projections; make A *u* equal to the Semidiameter of the Column, and complete the Geometrical Square *b a* A *u*; on *a*, with the Radius *a b*, defcribe the Quadrant *b m u*, and draw the Diagonal *a* A, interfecting the Quadrant in *m*; Divide the Arch *b m* into

4 equal

4 equal parts, at the Points F, *e*, E, through which, from the Point *a*, draw Right Lines to cut the central Line, through which the Height of the *Plinth*, *Torus*, and upper part of the *Scotia* muſt paſs, draw both Ways at Pleaſure. Out of the upper part, take a Fillet at F, the Operation of which is on Left-hand at ABCD; take another at *e*, out of the third part, the Operation of which is on the Right-Hand, and the Remainder is the Scotia. Make *wn* equal to *nu*, then *wu* is equal to the Diameter of the Column. Divide *wn* into 3 parts, and make *xw* equal to one of thoſe parts, then will *xw* be the Projection of the Plinth, before the Upright of the Column. Draw *x* Q parallel to the central Line, which will determine the Projection of the Die. The Projection of the Plinth to the Baſe of the Pedeſtal, is equal to the Height of its Mouldings; and that of the Cornice to the Pedeſtal, to its own Height. The Projection of the upper Torus in the Baſe to the Column, is equal to the Center of the lower Torus. *To deſcribe the Scotia*, the Line 4 3 *zy* being drawn through the Center of the great Torus, draw the diagonal Line 3 2, which biſect in the Point 1, which is the Center of the upper Curve, and the Point 3 is the Center of the lower Curve, which together form the Scotia. The Projection of the Cincture is equal to the Center of the upper Torus, as alſo is the Fillet under it; and thus are the parts of the Pedeſtal and Baſe deſcribed. The next in order is the Capital and Entablature, which are repreſented in Plate CCCX. and divided as follows: Divide the Height of the Capital into 3 parts, the lower 2 determines the Height of the Oak Leaves, the others, the Volutes and Abacus, of which the Abacus is equal unto two 5ths, as on the Left-hand is exhibited. *To find the Projection of the Capital*, divide the Semidiameter of the Column at its Aſtragal into 5 parts, and make *gh*, the Projection of the Abacus, equal to 3, and the extream Projection of the Ovolo 3 and two 3ds.

P. *Pray, Sir, What do the Oak Leaves of this Capital repreſent?*

M. THE Bleſſing and Strength of the Nation: By the Bleſſing, I mean his preſent Majeſty, who could not have been our Sovereign Lord, had not a *glorious Oak* preſerved the ſacred Perſon of *Charles* II. from the Fury of his Enemies, *&c.* By the Strength of the Nation, I mean our naval Forces and Trade, which are both dependant on the Oak, and which no Nation in *Europe* can parallel for Strength and Duration.

P. *I ſee that you have introduced Palm Branches, aſcending out of the Cornucopia's, in the Place of the* Corinthian *Volutes, pray what do they repreſent?*

M. PEACE and Plenty, which we have always enjoy'd ſince the happy Reſtauration; but more particularly at this Juncture, when almoſt every Nation in *Europe*, beſides our own, are feeling the Miſeries of bloody Wars, wherein many Thouſands have been ſlain; we, by the prudent Management and great Care of his moſt ſacred Majeſty *George* II. live in Plenty, ſleep in Peace, ariſe at our Pleaſure, enjoy our Liberties, and keep, or diſpoſe of our Properties, according to our own free Wills; *Bleſſings that no other People in the World enjoy.*

P. *I alſo obſerve, that in the Abacus, there is a Star and Garter, inſtead of the common Ornament of the Fiſh Tail,* &c. *Pray what does that allude to?*

M. HONOUR, an Ornament more peculiar to this Nation, than to many others in the Univerſe, and yet is known but to very few of its People. I ſhall now proceed to the Diviſion of the Members in the Entablature. (1) *To divide the Architrave into its Members*, divide its Height into two equal parts at N, make CL equal to CN, and draw LM parallel to CN; through the Point N, draw the Line NO, both Ways, of Length at Pleaſure,

ſure, cutting LM in O; draw the diagonal Lines CO, NL, and NM, O*f*; on N, with the Radius N*a*, deſcribe the Semicircle *abce*, and, with the ſame Opening, on *e* deſcribe the Arch N*d*, interſecting the Arch *eb* in the Point *c*; through the Points *f*, *a*, *b*, draw Right Lines parallel to the Abacus of the Capital. Now, as the Line *f* includes the Height of the firſt Faſcia, and firſt Bead, take out the Height of the Bead, by the firſt part of the Method for taking out a Fillet. The Like is alſo to be taken from the ſecond Faſcia, as the interſecting pricked curved Lines on the Left of the central Line repreſent. The Height of the *Regula* is one 3d of the *Tenia*; the Projections of the parts of the Architrave are found thus; divide the Height of the Tenia, *viz.* the Regula, Cima, and Bead, into 5 parts, and ſet them off on the horizontal Line, the middle Faſcia projects 1, the upper Faſcia 2, the upper Bead 3, the Cima 5, and the Regula 6 parts. Alſo, (2) *To divide the Members of the Cornice*, divide the Height AB into 2 equal parts, and on its Middle, as a Center, deſcribe a Circle; with the ſame Radius on B, interſect the Circle, and from its Center, through the Interſection, draw a Right-Line that ſhall cut the Line IK in S: This Line IK muſt be drawn parallel to AB, at the diſtance of one half AB, or the Semidiameter of the Circle; make SR, RQ, and QP, each equal to SK; and through the Points R, Q, P, draw the Right Lines *t*R, *r*Q, and *o*P, at Right Angles to AB. Divide TB into 3 parts at VW, and through the Points V, W, B, draw Right Lines at Pleaſure, parallel to *t*R; alſo, through the Point A, draw the Line HA parallel to the former. Divide IP into 4 parts, give the upper 1 to the Regula, and the other 3 to the *Cima recta*. Divide PQ into 3 parts, give the upper 1 to the *Cima reverſa*, including the Fillet, (which take out, as before taught) and the lower 2 to the *Corona*. Divide QR into 4 parts, give the upper one to the *Cima reverſa* over the Modillions (out of which take the Fillet) and the lower 3 to the Height of the Modillion. Out of VT take a Fillet, and the Remainder is the Ovolo; take the ſame alſo out of VW and WB, and the Remainder is the *Dentils* and Cavetto; the Breadth of each Dentil is two 3ds, and the Interval one 3d of its Height. The Projection of the Cornice is equal to its Height: The Freeze is compoſed of 2 Cima's, or may be made vertical or upright at pleaſure.

Plates CCCXI. CCCXII. *Fractional Architecture, by Mr.* EDWARD HOPPUS.

THESE two Plates contain an Attempt to proportionate the five Orders in Architecture, which this Author publiſhed not long ſince, under the miſtaken Title of *Proportional Architecture by equal parts*, inſtead of *Diſproportional Architecture by Fractional parts*, which in Truth it is, as will appear by the following. In the firſt place, before we can proceed to form an entire Order, we muſt aſſign a certain Number of parts, into which its Height is to be divided, whereby we may proportion the Whole, and which, according to this Author, muſt be found as follows.

			Parts	
To proportion the	*Tuſcan*	Order, to any given Height, divide the given Height into	$10\frac{3}{4}$	and take 1 for the Diameter of the Column.
	Dorick		$12\frac{1}{3}$	
	Ionick		$13\frac{2}{3}$	
	Corinthian		$14\frac{1}{2}$	
	Compoſite		$15\frac{1}{3}$	

Here, in his very firſt ſetting out, he perplexes the young Beginner with fractional parts. To proportion the *Tuſcan* Order, the Height muſt be divided into 10 parts and three 4ths, which is not eaſy to be done by a young Beginner; and as he has not been ſo kind, as to lay down a Problem, *How to divide a Right Line into Integers and fractional parts*, I very much doubt, if he is a Maſter of ſo little Geometry, as to know it

it himfelf. To have made the Manner of dividing the Heights of the Orders familiar to a mean Capacity, he fhould have faid,

Divide the Height of the			which are equal to	Parts.
	Tufcan	Order into	43	10 $\frac{3}{4}$
	Dorick		37	12 $\frac{1}{3}$
	Ionick		41	13 $\frac{2}{3}$
	Corinthian		58	14 $\frac{1}{2}$
	Compofite		46	15 $\frac{1}{3}$

And of thefe Parts take 4 for the Diameter of the Column in the *Tufcan* and *Corinthian* Orders, (becaufe the Denominator of the Fractions is 4) and 3 for the Diameter of the *Dorick, Ionick,* and *Compofite,* for the fame Reafon. The next Thing to be confidered is, the Proportion of the Orders with refpect to each other, wherein we fhall alfo fee fomething very fhocking and difproportionate. But, before I proceed thereto, I muft reduce all his fractional Altitudes to one Denomination, that thereby the meaneft Capacity may be able to judge of the great *Difcord,* that is here offered to the World under the Name of *Proportional Architecture by equal Parts.*

The Parts affign-ed for the		Order being Parts.	are equal to 4th Parts.
	Tufcan	10 $\frac{3}{4}$	43
	Dorick	12 $\frac{1}{3}$	49 $\frac{1}{3}$
	Ionick	13 $\frac{2}{3}$	54 $\frac{2}{3}$
	Corinthian	14 $\frac{1}{2}$	58
	Compofite	15 $\frac{1}{3}$	61 $\frac{1}{3}$

Now, obferve the Difcord of their total Heights, *viz.* 43 the *Tufcan,* 49 and one 3d the *Dorick,* 54 and two 3ds the *Ionick,* 58 the *Corinthian,* and 61 and one 3d the *Compofite.*

The Difference betweeen the	is	parts.
Tufcan and *Dorick*	6 $\frac{1}{3}$	
Dorick and *Ionick*	5 $\frac{1}{3}$	
Ionick and *Corinthian*	3 $\frac{1}{3}$	
Corinthian and *Compofite*	3 $\frac{1}{3}$	

Now, as thefe Differences have not a common Excefs, they are therefore difproportionate, and confequently the Whole is abfurd, and unworthy of our Regard; for if the Height of the whole Order is falfe, its parts will be fo likewife; for which Reafon to fpend more Time and Paper in explaining them would be ridiculous, and is therefore omitted.

THE Members in this Medley are, in general, taken from *Palladio,* excepting the Bafe to the *Corinthian* Column, which is borrowed from *Barozzio,* and the very worft of the Kind, on Account of the fmall Aftragals between the two *Torufes,* that could be chofen. The Impofts in Plate CCCXII. are in general very heavy, and of too many parts, with Necks or Freezes much too low, that ought to have been one 3d of the whole Height. The Manner of proportioning a Door under the Impofts is a Robbery committed on poor *Serlio,* of which Door more will be faid, when I come to the Explanation of Doors and Windows. The Cornices C, B under it, which differ in their Bed-mouldings chiefly, I fuppofe, are given with the Architrave A, as proper Ornaments to fuch a Door, and which, I muft own, if well executed, would have no ill Effect. On the Left-hand is reprefented the Manner of diminifhing and fluting the Shafts of Columns, as alfo to determine the Pitch of Pediments, and to work their Mitre-joints at their Angle of meeting with a horizontal Cornice; as alfo of the *Cima reverfa* on the Heads of Modillions in and inclining (commonly called raking) Cornice, the Operations of which are defcribed at large in the Index, under the Words *Pediment* and *Modillion.*

Plates CCCXIII. CCCXIV. Compoſite *Baſes and Capitals of the Ancients, by* BAROZZIO, *of* Vignola, *and* S. SERLIO.

THESE two Plates contain ſome noble Deſigns of compoſed Capitals and Baſes, of which thoſe marked A and E, in Plate CCCXIII. are by *Barozzio,* and I believe were taken from the Capitals of the Temple of *Jupiter,* but all the others are from the Collection of the induſtrious *S. Serlio.* The Capitals B, C are indeed *Dorick,* the Leaves only excepted, which makes them compoſed Capitals, and of which that marked B is the moſt beautiful of all that I have yet ſeen. The Baſes D and G are both very noble, that of D is the *Attick* Baſe, and is ſhewn here only on account of its Ornaments; but that of G is a compoſed Baſe for the *Compoſite* Order, and one of the very beſt I have ſeen any where. In Plate CCCXIV. there are three very curious Capitals and three Baſes, of which that marked C is always to be rejected, on account of thoſe ſmall Aſtragals between the two *Toruſes,* which have not only an ill Effect in their being very ſmall, but indeed, when ſuch a Baſe ſtands very much above the Eye, there are no other Members viſible but a continued Line of repeated round Mouldings, ſeemingly ſitting immediately on each other, without Separation. The Baſe D having the *ſingle Aſtragal* next under the upper *Torus,* and the *double Aſtragal* immediately on the lower *Torus,* has ſomething in it very elegant, and worthy of our Attention. The *Attick Baſe* H is from *Barozzio,* and is given here only to ſhew the uncommon Manner of undercutting the upper *Torus,* making the Face of the Fillet under it reclining, inſtead of perpendicular, as is uſually done.

Plates CCCXV. CCCXVI. CCCXVII. Compoſed *Capitals, by* JOHN BERAIN.

IN theſe three Plates are contained twenty-four different Capitals of very great Invention, and different from all that we have been yet ſpeaking of, and which are of ſuch various Heights and Kinds, that without any great Difficulty there may be five choſen, which together are much ſuperior (in Invention) to thoſe commonly uſed to the five Orders by all the foregoing Maſters. *To find the Proportions of thoſe Capitals,* divide the Diameter of their Shafts next under their Aſtragals (they being deſigned chiefly for Pilaſters) into 60 min. and therewith meaſure and number the Height and Projecture of every part at your Pleaſure. The many Ornaments with which they are enriched are very helpful to Invention, not only for compoſing of new Capitals, which every Man that can has a Right to do; but many other noble Ornaments which naturally follow in the Courſe of Study.

Plate CCCXVIII. *and* Plate S, to follow Plate CCCXVIII. *The Orders of the* Perſians *and* Cariatides, *by Mr.* EVELYN, S. LE CLERC, *and* J. GOUION.

THE *Perſian* Order is no other than the *Dorick,* but inſtead of Columns its Entablature is ſupported by aged Men; and that of the *Cariatides,* is the *Ionick* Entablature ſupported by Women. I muſt own I think them both unnatural, altho' in great Eſteem by the Ancients; and indeed it doth repreſent very ſtrongly a natural Cruelty and tyrannizing Inhumanity in the Inventors, and wherefoever they have been executed they could not be but very ſhocking to every judicious Eye. The Tribunal in Plate S, done by *John Gouion* in the *Swiſs Guard-chamber,* in the *Louvre* at *Paris,* may have been pleaſing to a *French Tyrant,* but could never be ſo to a Lover of Humanity: But, beſides this ridiculous Cuſtom, of turning Mankind into Columns, there have been others

others who have ufed *Angels* with no lefs Severity, as reprefented by *Le Clerc* in Plate CCCXVIII. which is yet more fhocking than the former; therefore be it underftood, that I reprefent thefe Orders not as Examples for Practice, but to fhew, that the Ancients had their Follies, in many Cafes to as great a Degree as the Moderns.

Plate T, to follow Plate S, after Plate CCCXVIII. *The Manner of defcribing wreathed Columns, by* ANDREA POZZO.

THIS Mafter gives us three Methods for wreathing of Columns; the *firft Method* is reprefented on the Right-hand by Number I. and is wreathed as follows, *viz.* (1) Defcribe the *Dorick* Shaft, which is here reprefented by the dotted Lines, that go up from the Cincture B to the Aftragal A. (2) From A draw a horizontal Line, of Length at Pleafure, and therein, from the Point A, fet off 9 Diameters of the Column, from which Point draw a Line to B, and on which, with any Radius, defcribe an Arch, as A P. (3) Divide the Arch A P into 12 equal parts, thro' which, from the Center, draw Lines to meet the Outfide of the Column, as at *h* g, *&c.* and from thefe Points draw Right Lines parallel to the Cincture, as *h l*, *g k*, *&c.* (4) The whole Height of the Shaft being divided into 12 Parallelograms, defcribe Equilateral Curves on every of their Sides, as the Curve *h g* on *i*, and *l k* on *m*, &c. and they will compleat the Contour, or Out-line of the Wreath, as required. The *fecond Method* is reprefented by Fig. II. as follows, Divide the Height of the Shaft into 3 parts, and fet on the Line from the Bafe 1 part from the Upright of the Shaft (which is fuppofed to be firft delineated) to C, then on the Points C and D, with the Radius C D, interfect in E, on which, as a Center, defcribe the Arch D C, which divide into 12 parts, and from thence draw Right Lines parallel to the Bafe, cutting the Out-line of the Column in the Points *b*, *a*, &c. then will the Shaft be divided into 12 Parallelograms, as *b*, *e*, *a*, *d*, &c. This done, divide the Side of every Parallelogram into 4 parts, and with 3 of thofe parts defcribe *Ifofceles Triangles*, as *b c a* and *e f d*, &c. on whofe angular Points, as *c* and *f*, defcribe the Curves neceffary to compleate the Shaft, as required. The *third Method* is reprefented in Fig. III. wherein 'tis fuppofed, that the Out-line of the Shaft is delineated as before. (1) Draw G F, and make L F and I H equal to the Diameter F H, and draw the Line L I, which will be divided into 2 unequal parts by the Line G F. (2) Make I N equal to the greateft Segment or Part of L I, and draw M N parallel to L I. Now it is to be obferved, that the Line F G, as it afcends, fhortens the greateft Segment of every horizontal parallel Line in a gradual Manner; and it is from thofe Segments that the Heights of all the Parallelograms are determined, *that is to fay*, the Length of the greater Segment of every horizontal Line is the Height of the next Parallelogram above it; and their Diagonal Lines being drawn out until they interfect each other, as in the Plate is reprefented, their Angles of meeting are the feveral Centers, on which the wreathed Curves may be defcribed, as required.

Plates V, T and W, to follow Plate CCCXVIII. *Divers Defigns of Obelifques, by* S. SERLIO, *compofed with Defigns of modern Architects.*

IN the firft of thefe Plates are four Defigns for Obelifques, R, Q, P, O, by *S. Serlio*, wherein is a fimple Grandeur and Majefty, not to be found in the other; on the Left, or in thofe of Plate W, which are poor Inventions of modern Pretenders, and whofe Pedeftals with fmall Mouldings have no Affinity to the plain folid Body they fupport. The proper Bafement for an Obelifque is a plain Cube, whofe Diameter muft be one 3d greater than the Obelifque at its Bafe, which may be ufed alone, or placed on a *Plinth* of

of half its Height, either with or without a ſquare, plain Capping (of one 4th its Height if with a Capping) on the Pedeſtal muſt be placed a ſquare *Plinth*, equal in Diameter to the Die of the Pedeſtal, and in Height equal to the Semidiameter of the Obeliſque, on which the Obeliſque muſt be placed; but if without a Capping, with a Plinth only, then the Cincture of the Obeliſque muſt ſtand immediately on the Cube. The Height of the Obeliſque (to be grand) muſt be 12 Diameters, diminiſhed one 4th, and finiſhed with a Right Angular Vertex. An Obeliſque thus compoſed will appear noble in every View, which thoſe whoſe Pedeſtals are made with ſmall Members (as in Plate W) cannot do, they being inconſiſtent with the *Majeſty* and *Grandeur* which theſe monumental Pillars ſhould repreſent, and are only fit for Lamp-poſts in Streets.

Plate X W, to follow Plate W, after Plate CCCXVIII. *The Manner of building Pilaſters of Stone againſt Brick Walls, by* S. SERLIO.

THE three Figures, repreſented on this Plate, exhibit the ancient Ways or Methods for facing or incruſtrating Brick Walls with Stone, and placing one Order over another; wherein is ſeen, that the Projection of the Pedeſtal, to the upper Order, is equal to the Upright of the Freeze of the lower Order, and which is abſolutely right, and good Architecture, altho' it doth require the lower Wall to be very ſubſtantial. To incruſtrate Brick Walls, we ſhould firſt complete the Brick-work, and let it be entirely ſettled before we begin to face it with Stone, otherwiſe the Work cannot be ſound, nor will the Walls ſtand perpendicular, altho' built ſo with the greateſt Care; and this is often ſeen in many Buildings incruſtrated with Stone, which have been carried up with the Brick-work, wherein the inward Side of Brick, having perhaps 8, 10, 12, or more Joints of Mortar, to one of the Stone Outſide, doth, in its drying, ſettle 8, 10, 12, or more Times as much as the Stone; and as the Stone Facing muſt, at proper Places, have heading Pieces laid into or a-croſs the Wall to bind in the outer parts, if thoſe Pieces do not break by the Weight of Bricks they ſuſtain, they muſt change the horizontal Poſition, they were firſt laid in, into an inclining one, or the Brick-work beneath them muſt ſeparate and ſettle from them; and let either of theſe be the Caſe, the Wall cannot be ſound. If I miſtake not ſomething of this Kind may be now ſeen in the Walls of St. *Giles's in the Fields*, lately rebuilt, which had the Stone and Brick carried up together, that cauſed ſome Irregularities by their different Settlements.

Plates CCCXIX. CCCXX. *Balluſtrades, by* S. LE CLERC.

IN the firſt of theſe Plates this Maſter gives us the Balluſtrades proper to each Order, and the Manner of placing them with Pedeſtals, from which the ingenious Student may compoſe others equally as good; thoſe at B and A, *&c.* are of different Kinds, not particularly adapted to any Order, but to be uſed diſcretionally. On the Right-hand, at the Bottom of the Plate, is an ancient Ornament uſed inſtead of Balluſtrades, called *Circular Interlacing*, which has a very good Effect, as alſo have the other ſix Kinds on the Left of Plate CCCXX. where are other Examples of Balluſtrades, as well raking in the aſcending Range of a Stair-caſe, as level in their *Landing Places*, *Balconies*, &c. as B A, B A C. The Balconies F, E, D, are Deſigns for Iron-work, to be uſed where the ſlighteſt Balluſtrade would be too maſſive.

Plate

Plates CCCXXI. CCCXXII. *Ballustrades, Balconies, and their Trusses, by Mr.* GIBBS.

IN the first of these Plates we have five Examples of Ballusters, which are proportioned to three Kinds of Ballustrades, and may be applied to the *Dorick, Ionick* and *Corinthian* Orders; the lowermost Figure may be applied to the *Dorick*. The Height of the Pedestal, in this and the other Orders, must be equal to the Height of the Entablature it stands over; or, for want of an Entablature, which sometimes may happen, we must suppose an Entablature of the Order we approve best of, to be placed on its Column only, under the Ballustrade, and make the Height of the Ballustrade equal to it. As the Height of the Ballusters is equal to the Height of the *Dado* or *Die* of the Pedestal, divide its Height into 8 parts for the *Dorick*, 9 or 10 (as in the middle Example) for the *Ionick*, and into 12 (as above) for the *Corinthian*. The Diameter of the Base of each Balluster is equal to 2 parts of its Height, and their Distance to 1 part; the Thickness of each at its Neck, and at the several Scotia's, is equal to 1 part, as may be seen by the half Ballusters described at large on the Sides of the Plate. By the several Subdivisions the parts of each of their several Members are determined. The Centers, for describing the Out-lines of the curved parts of each Balluster, are the Points where the several Diagonal Lines meet on the central Line of each Balluster. Plate CCCXXII. contains divers Designs for Balconies, which are represented as well in Profile as in Front, that thereby we may the better judge of their different Trusses made for their Support.

Plates CCCXXIII. CCCXXIV. *The ancient Fret Ornament,* Vitruvian *Scrolls, Interlacings, Eggs and Darts, by* S. SERLIO, *Mr.* EVELYN, *and Mr.* GIBBS.

THE first of these Plates contains a very great Variety of the ancient *Fret Ornaments*, by Mr. *Evelyn*, and Mr. *Gibbs*, with the Manner of turning them at an Angle, which indeed is the only Difficulty in making this Ornament. In Plate CCCXXIV. Fig. G is another Fret by Mr. *Gibbs*, and in Plate CCCXLI. are two others, and both returned at an Angle, of which that marked A is of my own Invention, and that marked B of Mr. *Edward Stephens*, an ingenious Cabinet-maker in *London*. It is to be observed, that as the Breadth of the Fillets (which are the unshadowed parts) are equal in Breadth to the shaded Distances between them, therefore, to make either of these Frets in any given Margin, Sofito, or other Breadth, divide it into as many equal parts as the shadow'd and unshadow'd parts contain; so the upper Fret of Plate CCCXXIII. is divided into 7 parts, and the lowermost into 9 parts, *&c.* The Figures A, D, F, Plate CCCXXIV. are divers Kinds of an Ornament, called the *Vitruvian Scroll*, perhaps from its being invented by *Vitruvius*. That marked A contains three Varieties by Mr. *Gibbs*, the other two are by *S. Serlio*. The other Figures marked B, C, E, H, I, are marginal Ornaments as the Frets, being Interlacings of various Kinds, of which those marked B, C, F, are by *Serlio*, and those marked H, I, by Mr. *Gibbs*, as likewise are the *Eggs* and *Darts* Fig. K, which are thus described; divide the Height of the Ovolo into 9 equal parts, and set 7 of them on each Side for the central Line of each Dart. The small Stars on the Left-hand are the Centers of the Curves that form the Egg, and the dotted Lines shew the Limits of each Curve. The Darts are formed by the dotted Lines which intersect each other, the one from the Top of the central Line of the Egg to the Bottom of the Dart, the other from the second Division, up the Dart, to the Top of the Dart on the other Side. Fig. L represents Husks and Leaves in the place of Darts, which are often used in many Works for Variety.

Plates CCCXXV. CCCXXVI. *Two Frontiſpieces for Gates, by* M. ANGELO.

THESE two Frontiſpieces are compoſed of all the Abuſes in Architecture that this Maſter could poſſibly invent; and altho' they are ſo vaſtly ſtrange, and of ſuch uncommon parts, yet there is a Grandeur in the firſt, and a Nobleneſs in the ſecond not undeſerving our Regard. To view and conſider the monſtrous Baſe of the Pilaſters in the firſt, whoſe Height is equal to their Diameters (without Precedent) its long necked Capital, clumſy Impoſt, low and ſmall broken Architrave, ſurpriſing high Freeze, and that broken over the Pilaſters, its aukward Cornice, open Pediment, with its little inſcriptional Table, and ſuper Pediment above that, one would think that its Inventor had never ſeen or heard of regular Architecture, and yet the whole taken together, without conſidering its parts, makes a very grand Appearance, if we can believe its upper part is not too maſſive for the lower. Fig. A, in Plate CCCXXVI. is a Profile of this Deſign, wherein we ſee, that the open Pediment has a very great Projection before the *ſuper Pediment*, which is alſo very conſiderable. The ſecond Deſign, in Plate CCCXXVI. being taken to Pieces, is as full of Abſurdities as the firſt; for here are maſſive Ruſticks environing the Shafts of the Columns, ſeparated by Aſtragals ſet very cloſe together in the lower parts, as if they had ſome mighty Weight to ſuſtain: The Entablature broken over each Column, the Bed-moulding cut in two by the Key-ſtones in the Freeze, the Cornice crowned with an open Pediment, with a Table juſt fit to contain the Name of its Architect, behind which riſes a kind of Parapet, finiſhed with Heads, like thoſe on *Temple-bar*: But the whole being taken together, and not critically reviewed, makes a noble and grand Appearance, whoſe Profile is repreſented on the Right-hand.

Plate CCCXXVII. *Iron Gates with* Tuſcan *Piers, after the* French *Manner.*

THE Piers of this Gate, having two three quarter Columns in Front, are very grand, and the Entablature being continued over the Iron-work, ſupported by the Side Pilaſters, is very ſtrong and ſecure. The Iron-work is very light and airy, and if liable to any Cenſure it is for its Work, which is rather too rich for the *Tuſcan* Order.

Plates CCCXXVIII. CCCXXIX. CCCXXX. *Three Examples of Iron Gates for* Dorick *Piers.*

THE firſt of theſe Deſigns repreſents a Pair of curious Gates, between two Piers, compoſed of *Dorick* Pilaſters, wherein 'tis to be obſerved, that if their Bodies be made ſquare, as in the Plan, they will cut into one another, and are therefore abſurd. This I mention here in order to prevent ſuch Abuſes for the future, and which at this Time almoſt every one who pretends to Architecture is fond of running into, altho' nothing can be ſo abominable; for two Bodies cannot poſſeſs the ſame Place at one Time; therefore I recommend the placing of entire Pilaſters, either ſingle or in Pairs, and not to ſplit one Pilaſter into 2 parts, and place 1 on each Side of the whole Pilaſter, as here is done. The carrying of the Entablature over the Gate is a very ſtrong Way of building, but is not ſo elegant and airy as Plate CCCXXIX. and CCCXXX. where the Entablature is broke all round its broken Pilaſters, of which that of Plate CCCXXIX. hath exactly the ſame Abuſe in its Pilaſters as that in Plate CCCXXVIII. and which is more viſible here, by ſeeing half Triglyphs on each Side the projecting Freeze of the entire Pilaſter, which are very ſhocking to conſider; whereas if the two Pilaſters had been made entire, and the Enta-

Entablature continued from the one to the other, then the Triglyphs would have been entire, and the Whole of grand and noble parts.

BEFORE I proceed any further, I muſt beg Leave to advertiſe, that the Deſign of theſe, and the nine following Plates is, *firſt*, to repreſent the many curious Deſigns for Iron Gates, of which we have none ſo noble yet executed in *England*; and *laſtly*, to expoſe the breaking of their Piers into ſo many ſmall parts, which makes them look not only very mean and poor, but contemptible in the Eye of every Judge, and which, to the eternal Shame of our preſent greateſt Architects, is daily done by them, as well in their capital, as in their ſmall Buildings.

Plates CCCXXXI. CCCXXXII. CCCXXXIII. CCCXXXIV. *Four Examples of Iron Gates for* Ionick *Piers.*

PASSING by the Deſign for the Iron Work, which is very rich, we come to the Piers of Plate CCCXXXI. which are ruſticated Pillars, wherein the Columns are inſerted, and crowned with the Entablature of their Order, and which may be pleaſing to many, and in ſome Degree juſtified, as that the Volutes of the Capital of the Column are not continued over the Ruſticks; yet I do inſiſt, that if a Pair of Columns were placed on each Side, with a continued Entablature, they would be more grand, and far exceed all that is afforded by the mean Variety of ſmall Ruſticks on each Side the ſingle Columns. The ſecond Example in Plate CCCXXXII. hath ruſticated Pilaſters, with half Pilaſters on their Extreams, with their Entablatures alſo, which is another Kind of Abuſe to be avoided; therefore in all ſuch Deſigns omit the half Capitals on each Side, as alſo the Freeze and Cornice over them, and then the Column or Pilaſter, with its Entablature, will be entire. The Mouldings of its Baſe ought not to be continued and returned, it being a Diminution of the Beauty, that ſhould be only ſeen in the Baſe of the Pilaſter. The Iron Work of this Gate is very magnificent and rich. I now proceed to Plate CCCXXXIII. whoſe Iron Work is of great Invention, but the Piers are, without Exception, the very worſt I have ever ſeen, the Front Pilaſter being backed by no leſs than two half Pilaſters on each Side; and, to play as many Monkey Tricks as was poſſible, we have an eſcallop'd Shell ſtuck up in the Stead of an entire Capital, with a Cove on each Side. It is my real Opinion, that ſuch abſurd Compoſitions, as this now before us, are the Delight and Study of many who profeſs themſelves very great Judges; but if we do but conſider the great Number of Angles and parts, into which it is divided, and the poor Effects, that their tall and ſlender Dimenſions have, we may ſoon be aſſured, that the Abilities of their Deſigners are no more capacious than themſelves; and of this Sort I believe the celebrated Mr. *Archer* to be the capital in this Kingdom, who, in his ſeveral Buildings, has expoſed to publick View more Abſurdities, than all the Architects, antient and modern, did before. The laſt Example of this Order is Plate CCCXXXIV. which is a very grand and noble Deſign, and wherein all the aforeſaid Errors are excluded. The Columns, which ſtand detached from the Walls, have a noble Effect, as likewiſe have the others, that are inſerted in the Walls.

Plates CCCXXXV. CCCXXXVI. *Two Examples of Iron Gates for* Corinthian *Piers.*

THE Piers to both theſe Deſigns are Parallelopipedons, the one having a Pilaſter, the other a Column inſerted in them, with their Entablatures continued, and which is to be juſtified, becauſe the parts of the Parallelopipedons on each Side of the Pilaſters and Columns, tho' crowned with their Entablatures, do not appear as half Pilaſters; and as in the Baſes to both Deſigns, the *Torus* and *Scotia* of each are maintained no where, but under the *Pilaſters* and

and *Columns*; the upper *Torus* and *Plinths* therefore may be allowed to continue throughout the whole Walling on each Side in both Deſigns.

Plates CCCXXXVII. CCCXXXVIII. *Two Examples of Iron Gates for* Compoſite *Piers.*

In the firſt of theſe Examples the Columns ſtand clear from the Pier, but in the laſt it is inſerted. Both theſe Deſigns are very good and grand, the Modillions in the laſt only excepted, which are entirely falſe; for as they repreſent the Ends of Joiſts, how can they be expected here, where the Entablature is broken all round, and where no Joiſts can be employed? Therefore to place Modillions in the Entablature of a Pier is abſurd.

Plate CCCXXXIX. *A Door with* Compoſite *Pilaſters, by* VITRUVIUS.

I have already repreſented a Door of this Kind by *Vitruvius,* which was of leſs Diameter at the Top than at the Bottom, and generally uſed to Temples for the Sake of ſhutting themſelves. The Height of this Door is 2 Diameters and one 4th, and its Diminution two 15ths of its Diameter at the Bottom. The Pilaſters on each Side are compoſed of the *Dorick* and *Corinthian* Orders, the Abacus being *Dorick* and the Leaves *Corinthian,* and which together form a very agreeable Capital, worthy of our Notice.

Plate CCCXL. A *ſemicircular and circular Window, with a Door, by* VITRUVIUS *and* S. SERLIO.

The uppermoſt Figure repreſents a ſemicircular Window divided into three Lights by two *Munions,* which moſt of the Architects of this Age call a *Palladian Window,* as if *Palladio* had been its Inventor: But, as in the Works of *Vitruvius,* this Window is repreſented, 'tis plain that *Palladio* was not its Inventor, and therefore I do aſcribe its Invention to *Vitruvius,* and call it a *Vitruvian Window.* As to the Merit of its Invention, I think 'tis not worth contending for; for if we conſider the Structure of a Semicircle, it will appear, that to place *Munions* for its Support is really needleſs, and indeed ridiculous, becauſe the Strength of the Arch is ſuch as not to ſtand in Need of any Support. But however, as the modern Taſte ſeems to countenance Abſurdities more than *real Beauties* and *naked Truths,* I have therefore given the Proportions for this Window. The Diameter being given divide it into 6 parts, ſet 1 and one 4th on each Side the Center, and give half of 1 to the Thickneſs of each *Munion,* whoſe central Lines will be at 60 deg. Diſtance from the Diameter. The Breadth of the Architrave is equal to one 6th of the Diameter of the Window. Theſe Windows are only proper to be placed in the Tympanums of Pediments, or to illuminate Stables, as thoſe of his Majeſty's Meuſe at *Charing-croſs*; but to place them in the Fronts of Noblemen's Houſes, as is done by Mr. *Flitcroft* in the Front of his Grace the Duke of *Montague*'s Houſe, in the *Privy-garden, Whitehall,* nothing can be more abſurd. The middle Figure is *S. Serlio*'s Method for proportioning a Door within a Geometrical Square, whoſe Aperture hath its Breadth determined by the Interſections of the Diagonals, and Lines drawn from the Middle of the upper Side to the two lower Angles, and its Heights by the Right Lines drawn perpendicular to its Baſe. *The Breadth of the Architrave* is equal to one 6th of the Aperture, and the open Pilaſters are equal to the ſame. The Freeze, Cornice and Pediment are made proportional to the Architrave, according to any Order, and after any Maſter at Pleaſure. The lower Figure repreſents, *the Manner of proportioning a circular Window in an Oblong or Paral-*

Parallelogram, whose Breadth is equal to twice its Altitude. The Diagonals being drawn, as also Right Lines from the Middle of the upper Side to the two lower Angles, let fall Perpendiculars from their Intersections to the Base; then taking the nearest Distance from the Center, to either of those perpendicular Lines, describe a Circle, which is the Window required, whose Architrave is equal to one 6th of its Diameter.

Note, The aforesaid Door is represented by Mr. *Hoppus* in Plate CCCXII. as of his own Invention, after that it had been publick by *Sebastian Serlio* for many Ages past.

Plate CCCXLI. *Rusticated Piers for Gates, by* INIGO JONES, *and the Earl of* BURLINGTON.

THE upper Pair of Piers are the Invention of *Inigo Jones,* and the lower of the present Earl of *Burlington*; in which last 'tis observable, (1) That the Fret Ornament, next above the Rusticks, doth not end as it begins, wherefore I am of Opinion, that if this noble Architect had thought proper to have begun the Fret from the central Line of the Pier, instead of one End, and made each equidistant part the same; then the Termination of the Fret on each Side, would have been equal, and which it ought to have been, as being both seen and considered at one View. (2) The upper part, against which are stuck *Festoons of Drapery* (which are more proper to adorn the *Drapers Shops* at *Charing Cross,* than the Entrance into a Nobleman's Palace) have a Projection equal to the Rusticks underneath; which, if I mistake not, is *false Architecture*; for here the lower part of the *Pier,* which ought to have been the most massy and strong, is made the weakest, and is therefore an unpardonable Absurdity. The Frets A and B are described with Plate CCCXXIII.

Plates CCCXLII. CCCXLIII. *Windows and Niches, by Mr.* GIBBS.

HERE are represented three Designs for Windows, each consisting of two Diameters in Height: The first with a *circular Pediment,* the Middle one with a *raking Pediment,* and the last, without either, being finished with a *swelling Freeze* and *plain Cornice.* If we are to make these into Niches, as in Plate CCCXLIII. then the Diameter of each *Parallelogram,* which before was made into Windows, being divided into 10 parts, give 8 to the Diameter of the Nich. The Breadth of the Architrave to each is equal to one 6th of the Diameter.

Plate CCCXLIV. *The ancient Manner of proportioning and placing Windows between Pilasters or Columns, by* S. SERLIO.

ALTHO' *Serlio* gives us this Example, which I believe he took from one of the Altars in the *Rotunda at Rome*; and altho' Sir *Christopher Wren* has ornamented the upper Windows of the Cathedral of St. *Paul's London,* in this very Manner with Pediments, supported by Columns on Pedestals; yet I must here observe, that the Method of placing small Columns, or Pilasters, in any Front, where there is a large Order seen with them at the same Time, is absolutely a *Gothick Mode,* and to be avoided by every one that delights in good Architecture. For, as all Things are said to be small, when compared with larger of the same Kind; so these small Columns appear diminutive and poor, when seen and compared with greater at the same Time. Therefore, as Pediments and Entablatures are necessary Ornaments over Windows and Doors, they cannot be better applied in any Manner, than is done by Mr. GIBBS in Plate CCCXLIII. wherein there are three Varieties, which are all very good.

Plates CCCXLV. CCCXLVI. *Two* Tufcan *Frontifpieces, by* ANDREA BOSSE.

IN the firft of thefe Plates, is reprefented, a very good *Tufcan* Frontifpiece, with a *raking Pediment*, whofe parts are adjufted by Feet, Inches, and Lines, according to the *French* Meafure; that is, by Feet, Inches, and 12th parts of an Inch, they calling every twelfth part of an Inch, a Line. At the bottom of this Plate is a Door after the *Palladian* Manner, from which I believe Mr. *Gibbs* learned to make his rufticated Doors: But furely, nothing can be fo monftrous as this, where the whole Entablature is entirely cut through, for the fake of introducing a heap of Key Stones, that have not any Bufinefs there, any more than the Rufticks, and mangle the Architrave on the Sides into many pieces, which ought to be entire.

IN Plate CCCXLIX. is another wretched Door by *Pallidio*, of the *Ionick* Order, whofe Entablature is cut quite through, in the fame Manner; which otherwife (as this we have been now fpeaking of) would have been a good Defign, that is, either with the Rufticks only, or having them entirely excluded: The Frontifpiece repefented in Plate CCCXLVI. is a very majeftick Defign, whofe parts are expreffed by Modules and parts, as well as by Feet and Inches.

Plates CCCXLVII. CCCXLVIII. *Two* Dorick *Frontifpieces, by* A. BOSSE.

HERE is alfo in the firft of thefe Plates a very grand Defign, with a *raking Pediment*, together with its *Profile* on the Right, by which its *Projection* is the better underftood. The parts hereof are meafured by Feet and Inches, and contain fuch as the Figures exprefs. In the lower part of this Plate is another *Palladian* Door, which having efcaped the Havock as the other underwent, is therefore a tolerable good Defign, tho' not the very beft I have feen of the Kind; and which would yet be better, if the *Mouldings* of its *Impofts* were not fo numerous, that, by its being more fimply plain, it might be more agreeable to the Plainnefs of the Rufticks. The arcaded Frontifpiece in Plate CCCXLVIII. is a very elegant Defign, whofe parts are determin'd as well by Feet and Inches, as by Modules and Parts.

Plates CCCXLIX. CCCL. *Two* Ionick *Frontifpieces, by* A. BOSSE.

BOTH thefe Defigns are finifhed with *circular* (commonly called by Workmen *compafs*) *Pediments*, the firft on a *Sub-plinth*, which may be ufed as Occafions require; the other with *Pedeftals* detached from the *Pilafters*, as exhibited in the Plan: The parts of both thefe Defigns are meafured as well by Feet and Inches, as by Modules and Parts.

Plates CCCLI. CCCLII. *Two* Corinthian *Frontifpieces, by* A. BOSSE.

THE firft of thefe Defigns hath a Scheme Arch, for the Head of its Door, which has a good Effect, as likewife hath its Pilafters, Entablature, and Pediment, whofe Pitch or Height of its Vertex above the Horizontal Line of the *Regula* on the *Cornice*, is equal to one fourth part of the Extent of the *Cornice*; and which I muft own, I think has a more noble and majeftick Appearance, than the low Pediment-pitch of *Palladio*'s, whofe Height is but two 9ths of its Extent. As this, and the following Defigns are enrich'd with Modillions, I muft beg leave to obferve, that as Modillions in level Cornices were originally made by the ends of Joifts in large Buildings, which were left longer than ordinary for the Support of the *Corona*; fo, for the fame Reafon, the Purloyns at Gable-ends of Buildings were continued out, to help fupport the raking Cornice to Gable-ends, from which Pediments were firft taken: Now if we confider, that the

the Modillions in a Frontiſpiece of a Door cannot be conſider'd as the Ends of Joiſts, and of Purloyns as aforeſaid, 'tis therefore evident, that they ought not to be imployed there, as being directly abſurd; but however, as Cuſtom has made them common, and as they are an Ornament and Strengthening to the *Corona*, (tho' not ſo great as Joiſts are) we will therefore conſent to their being uſed herein, provided they are not carried out in the Cornice, further than the Upright of the Freeze, where they cannot have any pretence to a ſolid Bearing, as this Maſter, and I think all others, very erroneouſly have done. The other Deſign in Plate CCCLII. is an Arcaded Door with Pedeſtals, and a raking Pediment alſo; and which is a very good Deſign, and would make a much finer Appearnce, had not the Engraver, by Miſtake, ſhorten'd the Projection of the Cornice, which makes it appear contracted, in its natural Extent. The Scales by which theſe Frontiſpieces are deſcribed are Feet, Inches, and Lines, and Modules and Parts, as in the preceding.

Plate CCCLIII. *A* Compoſite *Frontiſpiece, by* A. BOSSE.

THIS Frontiſpiece repreſents the *Compoſite* Order complete, in its Pedeſtal, Column, Impoſt, Arch, Capital, Architrave, Freeze, Cornice, and Balluſtrade; and had not here the Engraver miſtakenly ſhorten'd the Projection of the Cornice, the whole would have made a very magnificent Figure. The Scales for this Frontiſpiece are Modules and Feet, as in the foregoing.

Plate CCCLIV. *The Manner of inſerting Columns in a Wall, by* A. BOSSE.

As I have given a very great Variety of Deſigns for Doors, Windows, and other parts of Buildings, wherein Columns are employed, I ſhall now give you this Maſter's Method of inſerting them in Walls, which take as follows. The three Figures here repreſented are the Pedeſtal and Column of the *Tuſcan*, *Dorick*, and *Ionick* Orders, where the Circles, or Plans of their Shafts are each divided into 8 parts, of which 3 are inſerted, and 5 project from the Upright of the Wall. The Thickneſs of each Wall, in which they are inſerted, is equal to 1 diam. and a half, or to 3 mod. or Feet, as the Figures expreſs.

Plate CCCLV. *The Manner of finding the Skew-backs (and dividing all the various Kinds) of Streight and Scheme Arches, both regular and rampant.*

IN order to underſtand well the Magnitudes of Windows, I have reduced them here to three Kinds, *viz.* to three different Magnitudes, of which the firſt is the *geometrical Square*, of one Diameter in Height; the ſecond, the Parallelogram of 2 diam. or the double Square; the third, the Parallelogram, whoſe Height is equal to the Diagonal of the firſt Kind, that is, equal to the Diagonal of a Square, whoſe Side is equal to its own Diameter. Theſe Heights are, in each Kind of Window, to be conſidered ſeparately from the Height of the Arch on their Heads, be they either *Scheme*, *Semicircular*, *Elliptical*, &c. Before we can proceed to the Diviſion of the Courſes for a Brick Arch, we muſt conſider and meaſure the Thickneſs of our Bricks, and the Size of every Diviſion in the upper part of the Arch muſt be ſomething leſs, than a Brick's Thickneſs, that a ſmall Allowance may be made for its Diminution in rubbing. This being done, we muſt then proceed to find out the Height of the Arch, that will be proportionable to the Diameter of the Window, which is done by this

GENERAL RULE.

DRAW the Diagonals of a Square, as in Figure A; from the Center f raiſe the Perpendicular $f\,b$; on f, with the Radius $f\,d$, deſcribe a Circle, cutting the

the Perpendicular in *b*, through which draw the Line *a c* for the Height of the ſtreight Arch; and if a ſcheme Arch be required, then, on the Center *f*, with the Radius *f e*, deſcribe the Arch *d b e*, and, with the Radius *f c*, the Arch *a b c*. The skew Back of this Arch is the Diagonals of the Square, and which of all other ſtreight Arches is the ſtrongeſt, as requiring the leaſt Butments for its Support. In the dividing out the Courſes, always obſerve to divide them odd, for thereby the odd one will ſtand perpendicular over the Center, and the others on each Side will be correſpondently equal. As to the Term, *ſtreight Arch*, it is very abſurd, becauſe nothing can be ſtreight, that is arched; but, however, as the Courſes in theſe Kinds of Arches, as they are called, have reſpect to the Center of an Arch; as the Courſes of the *ſtreight Arch a c d e*, Fig. A, are no other, than the Courſes of the ſcheme Arch *a b c*, *a b e* continued towards the Center *f*, they may therefore be called *ſtreight Arches*, as being in ſome Degree affected by diviſionary Lines of a real Arch. *To divide the Courſes in ſtreight Arches*, there are two Methods; the one is, to divide the circular Arch, as *a b c*, into an odd Number of equal parts, and draw Right Lines from thence to the Center, which will divide the ſtreight Arch into the ſame Number of parts, but unequally; and the other Method is, to divide the upper Line of the ſtreight Arch into an odd Number of equal parts, without any regard to the circular Arch, as Figure C, and which I think is preferable to the former. The Figures B and E repreſent another kind of skew Back, whoſe Center is at *g* and *f*, the Diſtance of 2 diam. from the Top of the Arch *n*; and it is here to be obſerved, that the leſs the skew Back is, the leſs is the Height of the Arch, and which is cauſed by the greater or leſſer Diſtance of the Center, from the Head of the Window. Now as the skew Back of the Windows A C D, which are all the ſame in the greateſt Extream, and the Windows B E are of the leaſt Extream, I have therefore introduced two Means, *viz.* the Windows F I, whoſe Centers of their skew Backs are at equilateral Diſtances; and the Windows G K M, whoſe Centers are in the Center of their Baſes, and which laſt I think to be the moſt graceful of all the others. The Arch to the Window M is deſcribed by the Interſection of Right Lines, as following; the Height of the ſtreight Arch being firſt found, as *a k l m*, ſet up the Point *b*, on the central Line of the Window, ſo that its Height above the Line *a k* be equal to one 4th part thereof; and draw the Lines *a b*, and *b k*, which divide into any Number of parts, each the ſame; and then drawing the Right Lines 1 *c*, 2 *d*, 3 *e*, 4 *f*, *&c.* they will form the arched Line required, which divide into Courſes, as before directed. The Windows H L are called rampant Windows, the one having a ſcheme Arch rampant, the other a ſtreight Arch rampant. *The ſcheme Arch is thus deſcribed*, Let *g n* be the Difference of Height above the Level, draw the Line *g m*, and the central Line *b o p s* alſo, becauſe on the central Line the Center for the Courſes is to be found; make *o s* equal to 3 times *o m*, then the Point *s* is the Center for the skew Backs and Courſes, to the level Arch, and on *m*, with the Radius *m s*, and from the Point *s* draw the Lines *s a s l* at pleaſure; make *l m* equal to the skew Back, deſcribe the Arch *s t*; draw the Line *m r* through *q* the level Bottom of the Window, cutting the Arch *s t* in *r*, which is the Center of the rampant Arches *a l* and *g m*.

THESE Arches may be deſcribed by the Interſection of Right Lines, in Manner of the Arch to the Window M, as follows: Draw a right Line from *a* to *l*, and ſet up the Point *b*, from thence on the central Line, equal to one 4th of *g m*, and draw the Lines *a b*, *b l*, which divide into equal parts, *&c.* as in the Window M. The rampant ſtreight Arch, Figure L, hath the ſame skew Backs as that of Figure H, and its Limits *a d* are found as *a l*, in Figure M.

Plate

Plate CCCLVI. *The Manner of describing all the Varieties of regular Semicircular, Semielliptical, and* Gothick *Arches, in Brick-work on Windows of the first Magnitude.*

EXAMPLE I. *Of a semicircular Arch*, Fig. A

LET *g f h* be the Diameter, make the Breadth of the Arch *h c* equal to one 4th of the Diameter, or half *f h*; on *f* describe the Semicircle *a b c*, and concentrick thereto the Semicircle *g h*; divide the outer Semicircle into an odd Number of equal parts, each of which to be within the Thickness of a Brick, as before observed; and from thence draw Right Lines to the Center, which will be the Division of the Arch required.

EXAMPLE II. *Of a semielliptical Arch on the longest Diameter*, Fig. B.

THIS Kind of Arch is often used where the Height will not admit of a semicircular Arch, and which is described, as follows: The Diameter *d o*, and Height *i n* being given, and placed, as in the Figure, at Right Angles to each other, describe the Semiellipsis *d n o*; make *o c* and *b n*, each equal to one 4th of *d o* the Diameter, and describe the Semiellipsis *a e b m c*. *To describe an Ellipsis* hath been already taught by divers Methods; but, lest they should have escaped the Memory, and it being troublesome to turn back to those Rules, I will here repeat so much of them, as concerns our present Purpose: Make *d h* equal to *n i*, make *g h* equal to one 3d of *h i*, make *i k* equal to *g i*, and *g l* and *k l* each equal to *g k*; from the Point *l*, thro' the Points *g* and *k*, draw the Lines *l g e*, and *l k m*; on the Points *g* and *k*, with the Radius *g a*, describe the *Hanches*, *a e* and *m c*; and on the Point *l*, with the Radius *l e*, describe the *Scheme e b m*, which will complete the outer Curve *a e b m c*. On the same Centers describe the inward Curve *a n o*. *To divide the Courses in a semielliptical Arch* there are two Ways, and both of different Effects: The first is, to divide the outer Curve, as *b m c*, into equal parts, agreeable to the Thickness of a Brick, and draw the Courses to the Center of the Arch, in which every such Division happens; so all the Courses in the *half Scheme b m* are drawn to the Center *l*, and all the Courses in the *Hanch m c* are drawn to the Center *k*. Now, as these Arches are of different Curvatures, and both divided equally in their outer Curves, it therefore follows, that the inward Curve must be unequally divided, and the Thickness of the Courses within the *Hanch* must be much less, than the Courses within the *Scheme*. The second Way is, to divide the inward Curve, as *d f n*, into the same Number of parts, as you divide the outer Curve *a e b*; and then, drawing Right Lines from one to the other, they will be the Courses required. It is by these two Methods, that all other Arches, which consist of more than one Curve, are divided, excepting the semielliptical Arch, Fig. C, which is the next Example in course.

EXAMPLE III. *Of a semielliptical Arch on the shortest Diameter*, Fig. C.

THESE Arches are oftentimes used in particular Places, where the Height of a Semicircle of equal Diameter would be too low. *To describe this Arch*, the Diameter *f o*, and Height *m h* being given, and placed at Right Angles to each other, as in the Figure, find the Centers *k, l, n, p*, as in the last Example, and on the Centers *n, l, k*, describe the Curves *f g, g h i*, and *i o*; and on the same Centers, at any assigned Distance, suppose *o e*, necessary for the Breadth of the Arch, describe the Curves *a b, b c d, d e*, which divide into an odd Number of equal parts, agreeable to the Thickness of a Brick, (as before observed) as at 1, 2, 3, 4, *&c.* This done, take in your Compasses the Height of the Arch *c m*, and with that Distance set one Foot in the several Points of the outward Curve 1, 2, 3, 4, *&c.* and turn the other Foot, to fall on the Diameter

f o, and at every ſuch Time lay a Ruler, from the ſaid Points 1, 2, 3, 4, *&c.* to the Points in the Diameter *f o*, on which the Foot of the Compaſſes fall, and drawing Right Lines, they will be the Courſes required.

EXAMPLE IV. *Of the firſt Kind of* Gothick *Arches*, Fig. F.

The Diameter *f g*, and Breadth of the Arch *g h*, being given, with the Radius *fg*, on the Points *g* and *f*, deſcribe the Arches *a c*, *f e*, *c h*, and *e g*; divide *a b* and *d h* into any Number of equal parts, agreeable to the Thickneſs of a Brick, and draw Lines from thence to the Centers *g* and *f*, which will be the Courſes required. This Arch may have its Courſes divided, as in Fig. D, where the inward Arches, *h e* and *e g*, are each divided into the ſame Number of equal parts, as the outward Arches, *a h* and *b c*; and Lines drawn from the one to the other, will be the Courſes required.

EXAMPLE V. *Of the ſecond Kind of* Gothick *Arches*, Fig. E.

The Diameter *g m*, and Breadth of the Arch *a g* being given, divide *g m* into 3 parts, at *h n*; make *g p* and *m g*, each equal to *g n*, and draw the Lines *p n k*, and *g h b*, alſo *q n d*; with the Radius *n m*, on the Points *h*, *n*, deſcribe the Arches *g f* and *i m*; alſo, on the ſame Centers, the Arches *b a* and *k l*; with the Radius *q f*, on the Points *q* and *p*, deſcribe the Arches *f e* and *e i*, and on the ſame Centers, the Arches *bc* and *c k*. Theſe Arches have their Courſes divided, either with reſpect to their Centers, as the Side *a b d*, or by both Curves being divided into the ſame Number of parts, as *c k l*.

EXAMPLE VI. *Of the third Kind of* Gothick *Arches*, Fig. G.

The Diameter *f n*, and Breadth of the Arch *n e*, being given, divide *f n* into 3 equal parts, at *i k*; with the Radius *i n*, on the Points *f* and *k*, deſcribe the Arches *k m*, *f m*, interſecting in *m*; alſo, on *i* and *n*, deſcribe the Arches *i l* and *n l*, interſecting in *l*; draw the Lines *m k d* and *l i b* at pleaſure; with the Radius *k n*, on the Points *i* and *k*, deſcribe the Semicircles *f g k* and *i o n*; on theſe Centers alſo deſcribe the Arches *ab* and *d e*; on the Points *m* and *l*, with the Radius *l g*, deſcribe the Arches *g h* and *h o*, alſo the Arches *b c* and *c d*; then divide their Courſes, with reſpect to the Centers of the Curves, as the Side *c d e*, or both Arches equally, as *a b c*, *f g h*.

EXAMPLE VII. *Of the fourth Kind of* Gothick *Arches*, Fig. H.

The Diameter *f i*, and Breadth of the Arch *a f*, being given, divide *f i* into 3 equal parts, at *g h*; with the Radius *f h*, on the Points *g* and *h*, deſcribe the Arches *f e* and *e i*, alſo *a c* and *c k*; then divide the Courſes, with reſpect to both Centers, as in the Figure, with a Key-ſtone on the Head of the Arch; or divide the inward and outward Arches on each Side equally, as in the aforeſaid Examples.

EXAMPLE VIII. *Of the fifth Kind of* Gothick *Arch*, Fig. I.

The Diameter *d g*, and Breadth of the Arch *g k*, being given, divide *dg* into 5 parts, at *l*, *m*, *n*, *o*; with the Radius of 3 of thoſe 5 parts, as *d n*, on the Points *l*, *n*, deſcribe the Arches *d p* and *o p*; alſo, on the Points *m*, *o*, deſcribe the Arches *g q* and *l q*; draw the Lines *p o i* and *q l b*; with the Radius *o g*, on the Points *l*, *o*, deſcribe the Arches *h g* and *d e*, alſo the Arches *i k* and *a b*; on the Interſections *p*, *g*, with the Radius *p h*, deſcribe the Arches *h f* and *e f*, alſo *b c* and *c i*; then divide the Courſes, with reſpect to the Centers of the Curves, as on the Right, or both Arches equally, as on the Left.

Plate CCCLVII. *The Manner of ruſticating Semicircular, Elliptical, and* Gothick *Arches.*

To divide the Ruſticks of theſe Arches over Windows or Doors, whoſe Diameters do not exceed ſix Feet, take this

GENERAL RULE. Fig. A.

MAKE the Length of the ftretching Ruftick fg equal to one 4th of the Diameter kf; defcribe the Semicircles k, e, f, and z, b, h, g; make the Breadth of the Key Stone in the upper Semicircle equal to one 9th part of the Whole, and the Side Stones each equal to one 4th of its Breadth; divide ba, the Breadth of one of the fide Key Stones, into 2 parts, and fet 1 up for the Height of the middle Key Stone; its Drop below the under Arch is equal to one 6th of its Breadth in the lower Semicircle. The Key Stones being thus proportion'd, divide each Side, as hg, into 4 parts; alfo divide fg into 4 parts, and make the heading Rufticks equal to three 4ths of fg. In this manner make the Key Stones to all the other Arches equal to one 9th of the Whole, their Side Stones to one 4th of themfelves, and the Remainders on each Side divide into 4 parts, either with refpect to the Centers of the Curves, or equally at Pleafure. The Figures B, C, D, E, F, G, H, I, are the fame Arches as before defcribed, and are divided into their Rufticks by the preceding Rule.

Plate CCCLVIII. *The firft Magnitude of Windows rufticated.*

THESE Rufticks are divided by this

RULE. Fig. D, Plate CCCLIX.

DIVIDE the Semidiameter of the Window into fix parts, give 1 to the half Breadth of the Key Stone, 1 to the Side Stone, and 2 to each Side Ruftick. The Height of the Side Rufticks are the fame, as in the ftrait Arches of Brick-work, and the Height of the Key Stone above the ftrait Arch is equal to nm, the Breadth of a fide Key Stone at its Top. To make the Rufticks on the Sides, Fig. D, Plate CCCLVIII. divide the Height into 6 parts; the Projection of the ftretching Rufticks is equal to the Skew-back, and that of the heading Rufticks to one 3d of the Diameter; which is alfo the Height of the Window Stool.

Plate CCCLIX. *The geometrical Conftruction of Semicircular, Elliptical and* Gothick *rampant Arches in* Brick-work.

EXAMPLE I. *Of a rampant femicircular Arch,* Figure A.

LET al be the Diameter of the Window, and ac the Height of the Ramp; draw cl; make eg, cb, and il, equal to ec, and draw bi and be; draw cd parallel to al, cutting be in d, the Center of the Arch cg; draw the Line cl, cutting the central Line in e, through which, from i, draw the Right Line ief, cutting the Diameter al in f, the Center of the Arch grl; on the fame Centers defcribe the Arches nm and mp; this done, divide the outward Curve $onmp$ into any Number of equal parts, agreeable to the Breadth of a Brick, and the inward Curve $acgrl$ into the fame Number of parts, and draw the Courfes required.

EXAMPLE II. *Of a rampant femielliptical Arch,* Fig. B.

LET gm be the Diameter, ih the Height of the Ellipfis, and ge the Height of the Ramp; draw em; make ed and ml each equal to hi, and draw dl; alfo draw abc parallel to dl, cutting fa in a, and nc in c; divide ed, di, il, lm, alfo fa, ab, bc, and cn, each into any Number of equal parts, and defcribe the Curves by Interfections, as has been already taught.

EXAMPLE

EXAMPLE III. *Of a rampant* Gothick *Arch*, Fig. C.

LET *eb* be the given Ramp, *cg* the central Line, and *gd* the Height of the Arch; biſect *gd* in *m*, through which draw the Line *fmi*, parallel to *egb*; make *ef*, and *bi*, each equal to *mg*, and draw the Lines *fd*, and *di*; alſo draw the Lines *bc*, and *ck*, parallel to *fd*, and *di*, at the Diſtance of *ae*; divide *ef*, *fd*, *di*, *ib*, and *ab*, *bc*, *ck*, *kl*, each into any Number of equal parts, and drawing the Interſections, they will deſcribe the Arch required; which being divided within and without, and the Courſes drawn, will complete it as required. The ſix under Figures are Windows of the ſecond Magnitude, whoſe Ruſtick Heads are the ſame as thoſe of the firſt Magnitude.

Plates CCCLX. CCCLXI. CCCLXII. CCCLXIII. CCCLXIV. *Ruſticated Windows in all their Varieties.*

IN theſe five Plates, I have compriſed all the Varieties of ruſticated Windows and Doors, which being very plain in their ſeveral Diviſions, need no Explanation, and wherein the young Student will find much Pleaſure and Delight.

Plates CCCLXV. CCCLXVI. *Windows, by* S. LE CLERC, *and Mr.* GIBBS.

IN the Bottoms of the laſt two Plates are ſome Deſigns for Windows, by *Sebaſtian le Clerc*; and in theſe two Plates are many others by the ſame Maſter, which are given here for Examples; and as he hath alſo exhibited Views of their ſeveral parts at large, both in Front and in Profile, I cannot think, but that they will be helpful to Invention. In the upper part of Plate CCCLVI. are 5 Deſigns for Windows by Mr. *Gibbs*, whoſe Proportions are expreſſed by the dotted Circles. The Figures *b*, *c*, *d*, *e*, *h*, Plate CCCLVI. are Plans, Elevations, and a Section for a Niche, by *S. le Clerc*.

Plate CCCLXVII. Venetian *Windows, according to the modern Taſte.*

IN this Plate is contained nine Deſigns for Windows, of which thoſe marked B, E, H, are called *Venetian*. The upper Window B, in the Eyes of the Ignorant, makes as pleaſing a Figure, as the *patched Bawd* does in the Harlot's Progreſs, and indeed, not much unlike her, as being patched in the ſame Manner, with theſe miſerable little Block Ruſticks, which cut and mangle the Architraves and Entablature, in a moſt barbarous Manner. The Window E, is alſo another *apiſh* Invention; for here, not contented with defacing the Architrave, there are half Pilaſters ſet againſt the Columns, to make the Whole as abuſive as poſſible; whereas, had the Architraves been omitted, and heading Ruſticks introduced in their ſtead, or the Ruſticks wholly excluded, and the Architraves remain'd entire; the Deſigns would have been tolerable good. The *Ionick* Window H, hath its ſide Apertures too narrow for the middle one; and which is much affected by Mr. *Kent* in the *New Treaſury* at *Whitehall*, where it makes but a very poor Figure. The other Deſigns are in general very good, if rightly applied, that is, if the Windows A, C, F, be imployed in Fronts, where there are large Columns; and the others D, G, I, where there are not any ſeen with them at the ſame Time.

Plates CCCLXVIII. CCCLXIX. *The geometrical Conſtructions of ſemicircular, ſemielliptical, Scheme-headed Windows in circular elliptical Walls.*

BEFORE theſe Kinds of Arches are made, we muſt form the Centers whereon they are to be turn'd; and in order thereto, we muſt firſt make the Ribs as follow. Let the dotted curved Lines *c a b d*, and *v x t w*, Fig. I. Plate CCCLXIX. be equal to ſo much of the elliptical Plan, in Plate CCCLXVIII at Fig. I as is ſomething more than the Breadth of the Window, that is, make the Radius *a l*, and Arch *a b*, in Fig. I. Plate CCCLXIX. equal to the Radius I Q. and Arch I K H, in Plate CCCLXIX. alſo make *a x* in Plate CCCLXIX. equal to the Thickneſs of the Wall in Plate CCCLXIX and deſcribe the Arch *v x t w*, and draw the Chord Lines *a b*, *x t*; biſect *a b* in *r*, and thro' *r* draw the central Line *r l e*; divide the Chord Line *a b* into any Number of equal or unequal Parts, at the Ponts *g g*, &c. and laying a Ruler from them to the Center *l*, draw Lines to cut the Line *x t*, in the Points *n n*, &c. on the Point *r*, with the Radius *r a*, deſcribe the Semicircle *a e b*, and from the Points *g g g*, &c. and *n n n*, &c. draw Right Lines parallel to *n r f e*; of which the firſt, from the Points *g g*, &c. will cut the Semcircle in the Points *h h*, &c. make the Lines *n o*, *n o*, &c. drawn from the Points *n n*, &c. in the Line *x t*, equal to the Ordnates *g h*, *g h*, &c. of the Semicircle *a e b*; alſo make *n f* equal to *r e*, and through the Points *o*, *o*, *o*, *f*, &c. trace the Curve *x o o o o f t*, whoſe Ordnates *n o*, *n o*, &c. being equal in Height to the reſpective Ordnates *g h*, &c. of the Semicircles; and the Diſtance of the Ordnates *n o*, being proportional to the the Line *x t*, as the Ordnates *g h* are to the Diameter of the Semicircle *a b*; therefore if the Semicircle *a e b* be raiſed perpendicularly over its Diameter *a b*, and the Curve *x f t* over the Line *x t*, they will be the Ribs required. If a third Rib is required (ſuppoſe at *i k*, then by laying a Ruler from the Center *l* to the Points *g g*, &c. you will divide the Line *i k* into the ſame Number of Parts as are in *a b*, and in the ſame Proportion alſo, as you did the Line *x t*; and if from the Diviſions in the Line *i k*, you draw Lines parallel to *l e*, and make every one of them correſpondently equal to the Ordnates *g h*, in the Semicircle *a e b*, and through their Terminations trace the Curve *i z k*, it will be the third Rib required; and ſo, in like Manner, any other at Pleaſure.

THE Ribs being thus prepared and fixed in their Places, let them be covered with ſlit Deal, or rather Pantile Laths, which muſt project outwards, ſomething beyond the Upright of the Wall; and as the Covering of the Ribs muſt be conſidered before the Ribs are made; therefore, in their making, an Allowance for its Thickneſs muſt be made; ſo that the Whole together ſhall exactly fit the Arch required. The Center being thus made and fixed, the ſemicircular Rib *a e b*, Plate CCCLXIX. will be over the Line I D H, Plate CCCLXVIII. Fig. I. and as the Line I D H in Plate CCCLXVIII. is equal to *a r b*, in Fig. I. Plate CCCLXIX. the Semicircle I C H is equal to the Semicircle *a e b*, and if the Semicircle I C H be raiſed perpendicularly over the Line I H, it will be in the Place of the ſemicircular Rib; this being well underſtood, ſtrike a Chalk Line about the boarded Center from the Points I and H, ſo that it may be exactly perpendicularly over the Diameter I H, and let this Line be repreſented by the Semicircle I C H, which we'll ſuppoſe to ſtand perpendicularly over the Line I H; on a large Door or Floor, lay down a Triangle, equal to the Triangle I H Q, and on Q, with the Radius I Q, deſcribe the Arch I H; alſo on D deſcribe the Semicircle I C H; which will be equal to your Semicircle, deſcribed by the Chalk Line on the Center; divide I H into any Number of equal or unequal Parts, as at the Points 5, 3, 1, *y*, and from thence draw Right Lines at Right Angles to I H, until they meet

the Semicircle in the Points C, *x*, *w*, *v*, *q*; this done, transfer the several Points, *q*, *v*, *w*, *x*, C, &c. in the Semicircle on the Floor, to that described in Chalk on the Center, and from those Points draw outwards Right Lines at Right Angles to the Semicircle, as from C towards A, &c. then make C B equal to D K, *t x* equal to 6 5, *s w* equal to 4 3, *r u* equal to 2 1, *p q* equal to *z* [illegible], and through the Points B, *t*, *s*, *r*, *p*, H, a Line being traced, and the like done on the other Side, will the Curve to which the Arch must be set on the Center, that will be perpendicularly over the Base of the Window; for as the Semicircle I C H is perpendicularly over the Line I H, and as the Ordnates *z y*, 1 2, 3 4, 1 6, &c. are equal to the Off-sets from the Semicircle on the Center *p q*, *u r*, *w s*, *x t*, &c. and as the Off-sets *p q*, *u r*, *w s*, *x t*, are perpendicularly over, and parallel to the Ordnates *z y*, 1 2, 3 4, 5 6; therefore the Curve I *t s r p* H (on the Center is perpendicularly over the Base I K H, and to which the Face of the Arch must be placed as aforesaid. The Line G A F represents the Curve on a semicircular Center, whose Diameter is equal to the Line G F, wherein the Off-sets A B, *o n*, *m l*, *k i*, *h g*, *e f*, *d c*, and *a b*, are equal to the Ordnates K E 6, 13, 4, 12, 2, 11, *z* 10, * 9, * 8, * 7; and which has no Difference in the Operation from the former. The like is also to be understood in the Scheme Arch, Fig. V. at the other End of the Plan, and in the two elliptical Arches, Fig. III. and VII. on the Sides; and which, the Lines of each Figure makes plain at the first View. The Center being thus made, and prepared ready to receive the Arch of Brick, or Stone-work, we must now proceed to that Work as follows: (1) Let G I, Plate CCCLXVIII. be the given Breadth of the Arch or Architrave, that is to go about the Window; make H F equal to G I, and draw G F, which bisect in E, on which, with the Radius E G, describe the Semicircle G B F; divide G E and B F into any Number of equal or unequal Parts, as at the Points 7, 8, 9, 10, 11, 12, 13, &c. and from thence draw Right Lines to the Semicircle G B F, at Right Angles to itself, which will also cut the Semicircle I C H in the Points *q*, *u*, *w*, *x*, &c. (2) Make the Right Line A E, Fig. II. equal to the Length of the Curve G I K H F in Fig. I. also make A B, and D E in Fig. II. equal to G I and H F in Fig. I. (3) Divide A E in Fig. II. in such Proportion as G F in Fig. I. is divided, as at the Points *g*, *f*, *e*, D, *d*, *c*, *b*, *a*, C, &c. and from those Points draw Right Lines, right angled to itself of Length at Pleasure; this done,

	g h			7 *h*
	f i			8 *c*
	e k			9 *f*
	d l			10 *g*
Make	*c m*	in Fig. II. equal to		11 *i*
	b n			12 *l*
	a o			13 *n*
	C G			14 B
	&c.			&c.

and through the Points E, *h*, *i*, *k*, *l*, *m*, *n*, *o*, G, &c. describe the Semiellipsis E G A. In the same Manner, and on the same Lines, from the Points *d*, *c*, *b*, *a*, C, &c. set up the Ordnates of the lesser Semicircle *y g*, 1 *u*, 3 *w*, 5 *x*, D C, &c. and through their Extreams trace the Semiellipsis D F B, which is the Face (tho' elliptical as now expanded) of the semicircular Arch required, and whose Courses are divided equally, as well [illegible], as before has been taught in semielliptical-headed Windows. The Courses being divided as in the Figure, (and which is also represented by Fig. II. in Plate CCCLXIX. to prevent Confusion of Lines) draw Lines parallel to the Diameter B D, from every Point on the one Side, to the respective Point on the other, as from 1 to 1, 2 to 2, 3 to 3, &c. which will divide the Line C F into unequal Parts, at the Points 1, 2, 3, &c. this done, transfer the Divisions of the Line F C on any streight Piece of Wood, and fix it perpendicularly in the Center Q, (of Fig. I. Plate CCCLXVIII.) so that the Beginning of the Divisions be exactly level with the Diameter of the Arch; then divide the

Curve

Curve I *t r s p* H on the Center, in Fig. I. into the ſame Number of Parts, as you have the Semiellipſis B F D into Courſes, and which will be qual to each other; and then a Chalk Line being applied from each of thoſe Diviſions on the Center, to the reſpective Diviſions, in the Standard Piece, erected at Q, that is, from the firſt on the Center, to the firſt on the Standard, and from the 2d on the Center, to the 2d on the Standard, *&c.* ſtriking the Line at each Time, you will truly ſet out on the Center every Courſe as required. Laſtly, apply one Side of a Bevel to each Line ſtruct on the Center, with its Angle to the Curve on which the Arch is to be placed, and open the other Side, until it meet the Perpendicular of the aforeſaid Curve; and the Angle ſo taken, will be the true Angle, that the Sofito of every Courſe muſt make with the Perpendicular of its Front:

THE next and laſt Thing to be done is, *How to find the Curvature of every Courſe contained in the Arch*; which may be found as follows, Plate CCCLXX. Fig. IV. and V. Admit Fig. IV. to be a ſemicircular-headed Window in a cylindrical Wall, whoſe Arch is to be ruſticated with Brick or Stone, and 'tis required to make the proper Templets, for the forming of the Curvature of each Ruſtick; let *i l* be the Diameter of the Cylinder, and Window the Point *k*; deſcribe the Semicircle, and divide every of the Ruſticks, as before taught; continue the Sides of each Ruſtick both Ways, until the Lines meet the outſide of the Cylinder, as *h g*, to *x* and *m*, *f e*, to *w n*, &c. in any Part of the central Line *k q*, draw a Line at Right Angles to it, as the Line *x r*, interſecting it in *k*; on *k*, with the Radius *k r*, deſcribe the Circle *r q p*; divide one of its Semidiameters, as *p q*, into any Number of equal parts, (ſuppoſe eight) as at the Points 1, 2, 3, 4, 5, 6, 7, 8, and from them draw *Ordnates* parallel to *x r*; take one half the Line *x m*, Fig. IV. *viz.* *x k* or *k m*, in your Compaſſes, and ſetting 1 Foot in the Point *q*, turn the other to fall on *i*, in the Line *x k*, Fig. V. and through the Point *i* draw the Line *q i m*, making *i m* equal to *i q*; through the Point *i* draw the Line *n o*, at Right Angles to the Line *m q*; divide *m i* and *i q* into 8 equal parts at the Points 1, 2, 3, &c. thro' which draw Ordnates, which make equal to the reſpective Ordnates of the Circle *r q p*, and through their Extreams deſcribe the Ellipſis *m o q n*; take 1 half the Line *w n* in your Compaſſes, *viz. k n*, Fig. IV. and ſetting one Foot in *q*, with the other touch the Line *x k*, Fig. V. in *h*, through which, from *q*, draw the Line *q d* equal to *w n*, and through the Point *h* draw the Line *f h l*, which make equal to the Diameter of the Circle *p q*; divide *d h* and *h q* into 8 equal parts, and draw the Ordnates parallel to *f h l*, and equal to the reſpective Ordnates of the Circle, and through their Extreams deſcribe the Ellipſis *d l q f*. In like Manner make *g q*, Fig. V. equal to *k o*, Fig. IV. and through *g*, from *q*, draw the Line *q g b*, making *g b* equal to *g q*; through the Point *g* draw the Line *e c* equal to the Diameter of the Cylinder, and at Right Angles to *b q*, and then, dividing the Lines *b g* and *g q* each into 8 parts, draw the Ordnates equal to thoſe of the Circle, and through their Extreams deſcribe the Ellipſis *b c q e*. Laſtly, make *q x*, Fig. V. equal to *k s*, Fig. IV. and through *x* draw the Line *q x t*, making *x t* equal to *q x*; through the Point *x* draw the Line *w a* equal to the Diameter of the Cylinder, and at Right Angles to *t x q*; divide *t x* and *x q* each into 8 parts, and, drawing the Ordnates equal to the reſpective ones of the Circle; deſcribe the Ellipſis *t u q w*.

Note, If the Ordnates of the Circle be continued out to meet the Line *t q*, they will divide the longeſt Diameter of every Ellipſis, in the ſame Proportion as *p k* the Diameter of the Circle is divided; therefore, tho' I did before direct the dividing of the Diameter of the Circle into equal Parts, as being eaſier underſtood at firſt, yet 'tis plain, that, if it is unequally divided, 'tis the ſame Thing; therefore, if enough Ordnates are drawn, ſufficient to deſcribe the Curve of the Ellipſis, 'tis all that is required. Theſe ſeveral Ellipſiſes are to be conſidered as the Outlines of ſo many Sections of the Cylinder, which, in general, paſs thro' *k* the Center of the Window; and therefore the left Hand, or lower Ends, of the ſhorteſt Diameter of every Ellipſis, as the Points *w*, *e*, *f*, and

and *n*, will all fall together in the Side of the Cylinder at *k*; wherefore making the parts of each Ellipsis next above the shortest Diameters, as *w* 30, *e* 32, *f* 34, and *n* 36, each equal to *g k* Fig. IV. the Semidiameter of the Arch; and the next parts of each Ellipsis, *viz.* 30, 29; 32, 31; 34, 33; and 36, 35; each equal to *h g*, Fig IV. the Height of the Rusticks, they will be the Curvatures of those Rusticks; that is to say, (1) The Templets for the first Rustick *i h g*, are the Templets marked D, found on the Ellipsis *m o q n*, which is for the upper part *h g*; and a Templet made to the Curve of the Cylinder's Circle, is for its lower Edge at *i*. (2) The Templet C is for the Curve at *f e*, and the Templet B for *d c*; the Templet A is for *b a*, and the central Line of the Key Stone is perpendicular. The same Templets in the respective Parts on the other Side, work the same Effect. And thus is the Arch complete.

Now from this 'tis plain, that every Course in such an Arch being considered as a Section, passing through *k* the Center; the Templet required for every such Course, is that Part of the Ellipsis of every such Section that is at the same Distance from the End of its shortest Diameter, as the Course or Rustick is from the Center of the Window.

As I have thus demonstrated the Nature of these curved Courses of Brick or Stone, it now remains, *How to find on a plain Superficies, as on Paper, a Floor, &c. the Angles made by every Course contained in such an Arch*, which continued through the Center *k*, unto both Sides of the *Cylinder*, as before observed, are the longest Diameters of the Ellipsises of such Sections, whose shortest Diameters are all equal to the Diameter of the *Cylinder*; -- Make the Right-line D B, Fig. II. Pl. CCCLXIX. equal in length to the curved Line I K H, Fig. I. Pl. CCCLXVIII. and make CF, in Fig. II. aforesaid, equal to *g k*, the Semidiameter of the semicircular-headed Window in Fig. IV. Pl. CCCLXX. and describe the Semiellipsis D F B, which divide into such Number of equal parts, as are consistent with the Thickness of the Bricks; this done, draw Right-lines from the Center C, through the aforesaid Divisions, and they will be the Angles of the several Courses required: For if the Ellipsis be thus described on Paper, and applied against the Side of the *Cylinder*, so that the Line F C is perpendicular; then the Distance from the Center C, to every part of the Semiellipsis D F B, will be equal, (and the Points D, B will stand perpendicularly over the Points *g*, *g*, which are equal to the Chord-line, or real Diameter of the Window) and therefore will be semicircular, and the several Lines passing from its Center, through its Circumference, are the Angles required.

Now, seeing that the Plan in Plate CCCLXVIII. is an Ellipsis, or rather an Oval, which is composed of Segments of Circles; to find the Terminations of the long Diameters of the Arch, Fig. I. we must imagine that the Segment in which it stands, be the Segment of a Cylinder, whose Base is a Circle, and whose Semidiameter is equal to I Q: Wherefore drawing the Lines F E, and A G in Fig. II. Plate CCCLXIX. at the Distance of I Q (Fig. I. Plate CCCLXVIII.) on each Side F C they will represent the Sides of the Cylinder, at which all the longest Diameters of the several Ellipsises must terminate, and those Angles transferred to the Building, will be the Courses required. As I have not yet taken any Notice of the Division of Courses in Arches, with respect to the Bricks themselves, I must now observe, that each other Course in an Arch, whose Height is 14 Inches, consists of two *Stretchers*, as *n n* in Fig. II. Plate CCCLXIX. which are 7 Inches each in Length; and the other Courses between these of three Headers, as *a*, *a*, *a*; each of three Inches and one half, and two Closers, as *c*, *c*, each of 1 Inch and three 4ths, which are continued alternately throughout the Whole. Having thus explained all the parts belonging to a Window of this Kind, wherein I have been very copious, and which I hope is so intelligible as to be understood by Persons of mean Capacities, for whose Sakes I have compiled this whole Work. I must in the next Place observe, that the very same Methods and Lines are to be used in the Formation of the Centers and Arches of Elliptical and Scheme-head-

ed

ed Windows in ſuch circular Walls, and which is very evident, if we pleaſe to conſider the ſeveral Lines in Figures III. IV. V. VI. VII. VIII. and compare them with Fig. I. and II. Plate CCCLXVIII. as alſo Figures V. VI. and VII. with Fig. I. Plate CCCLXIX.

To make a ſtreight Arch in a circular Wall, Fig. III. Plate CCCLXIX.

LET the Circle C E D repreſent the Plan of a Cylinder, or round Tower, in which is to be made a Window, as between C and D, whoſe Head is level, and finiſhed with a ſtreight Arch of Brick; make the Right Line *g f*, Fig. IV. equal to the curve Line C D, Fig. III. which divide into Courſes, agreeable to the Thickneſs of the Bricks; make *q e*, in Fig. IV. equal to G A in Fig. III. and draw Lines from *e* through all the Diviſions in the Line *g f*, which are the Angles of each Courſe, that muſt be deſcribed on the Point A, and continued through both Ways, as *n n*, *l o*, *k p*, &c. Fig. III. for if Fig. IV. was horizontally applied againſt the Cylinder, with the Point *q* on the Point G, then the Points *g* and *f* would cap about, and ſtand over the Points C D, and the Lines *e k*, &c. drawn through the Center, and continued upwards and downwards to meet the Sides of the Cylinder, will be the long Diameter of thoſe Ellipſiſes, in whoſe Curves the Templets of each Courſe may be found, as before taught. The ſeveral Diviſions in the Plan of the Window between C D, muſt be equal to thoſe of *g f*, Fig. IV. and a Plane or Board ſo divided, and ſet level with the Head of the Window, and over its Plan are the Lines to which every Courſe of the Arch muſt be ſet.

BEFORE I proceed any further, I muſt beg Leave for a Digreſſion to obſerve, that altho' in the Conſtruction of Geometrical Figures in the Beginning of our Geometry, I have taught divers Methods of deſcribing Ovals and Ellipſiſes, and have alſo here, in the Conſtruction of ſemicircular-headed Windows, ſhewed another Method of deſcribing an Ellipſis to any Length and Breadth, by transferring the Ordnates of a Circle, whoſe Diameter is equal to the ſhorteſt Diameter of the Ellipſis, *&c.* which indeed are ſufficient for all Kinds of Buſineſs, where they are required; but yet, as there are three other Methods, that have ſince occurred to me, the Knowledge of which may be entertaining to the Curious, I will, for their Sakes, here inſert them.

To deſcribe an Oval *or* Ellipſis *to any Length and Breadth given*, Plate A, to follow Plate CCCLXIX. Fig. II.

METHOD I. Let *c b* and *a d* be the given Diameters; make *c q* equal to *a d*; make A *s* and A *t* each equal to two 3ds of *q b*, on *t s* complete the two equilateral Triangles *t y s*, and *t x s*, and draw out the Lines *t v*, *t w*, *s z*, *s i*; on *t* and *s*, with the Radius *c t*, deſcribe the Arches *w c v*, and *z b* I; alſo on *y* and *x*, with the Radius *x v*, deſcribe the Arches *v a z* and *w d i*, which completes the Oval required.

METHOD II. Fig. III.

LET *a h* and *b e*, be the given Diameters interſecting in *z*, on which, with the Radius *z a*, deſcribe the Circle *a d h c*, alſo, with the Radius *z e*, deſcribe the Semicircle *b f e*; divide the Quadrant *h d* into any Number of equal Parts, (ſuppoſe 8) as at the Points *h*, *i*, *k*, *l*, &c. and from thence draw Right Lines parallel to the Diameter *b e*, of Length at Pleaſure; alſo divide the Quadrant *f e* into the ſame Number of equal parts, as you did the Quadrant *h d*, at the Points *y*, *y*, *y*, &c. from whence draw Right Lines parallel to the Diameter *a f*, cutting the aforeſaid in the Points *x*, *w*, *v*, *t*, *s*, *r*, *q*, through which trace the quarter Part of the Ellipſis, and ſo, in like Manner, the Whole as required.

THIS Method is an Invention of *Sebaſtian Serlio.*

METHOD III. Fig. II. *By Means of a Tramel.*

LET $c\,b$ and $a\,d$ be the given Diameters, and $e\,f\,g\,h$ the Tramel fixed with its central Lines lying on the two Diameters; let $i\,k$ represent the Rod of the Tramel, on which are two sliding Points, as $p\,m$, with Screws on their Heads or Sides to fix them at Pleasure; let l be a fixed Point, made capable of receiving a tracing Pin, or Pencil; make the Distance $m\,l$ equal to half the shortest Diameter, and $p\,l$ to the Distance of half the longest Diameter; this done, put the Points p, m in the Groove of the Tramel, with the Point l to any of the Extreams of the Diameters, and turning it about, the Point l will describe the Ellipsis required.

RAMPANT ARCHES may be most expeditiously described, as in Figures T V, [illegible] Y Z. wherein T is a Semicircle; W, a Semiellipsis; and Y, a scheme [illegible] given; the Elevation of the rampant Diameters to the Figures V, X, Z, [illegible] at Pleasure; and, if therein be placed Ordnates equal to those in the Fi[illegible], W, Y, as represented, the Curves traced through their Extreams [illegible] the rampant Curves required.

[illegible] Sofito's of circular Windows being the next in Order, I shall proceed [illegible], before I can make any Beginning therewith, I must first shew

How to cover the Superficies of a Cone, Plate CCCLXX.

LET Fig. VI. represent a given Cone, and 'tis required to cover its Superficies with Pasteboard, Paper, Lead, *&c.* with the Radius $i\,b$, on the Side of the Cone describe a Circle, as Fig. VII. in whose Circumference assign a Point, as c; measure the Circumference of the Base of the Cone, and set it in the Circle, Fig. VII. from c to a, and draw the Lines $e\,a$, $e\,c$; cut out the Quadrant $a\,e\,c$, and the Remainder being applied, with the Point e on the Point i, it will exactly cover the Cone, as required: For, as every Point in the Circumference, from a to c, is equidistant from e, and equal to $i\,k$, the Side of the Cone; and as the Circumference of the Arch $a\,c$, Fig. VII. is equal to the Circumference of the Cone's Base, therefore it is equal to the Superficies of the Cone. *Q. E. D.* This being understood, which is very easily done, I will now proceed to shew,

How to line with thin Stuff, &c. *the Sofito of a Circular Window, as* Fig. VIII. Plate A, following Plate CCCLXIX.

LET $a\,c\,p\,q$ represent a Section of the Wall, in which stands the Window, Fig. VIII. wherein $e\,h$ is equal to the Height, or Diameter of the Window, $b\,f$ and $l\,n$ the Quantity of the Splay-back, and $b\,d$ and $n\,g$ the Splay-backs themselves; continue $b\,d$ and $n\,g$, until they meet in E, then will the Triangle b E n represent the Section of a Cone, whose Base is equal to the Diameter $m\,l$, or $h\,n$; or otherwise, if you suppose the Splay-back of the Window was to be continued, until all its parts meet in a Point, the Whole would form a Cone, whose Base is equal to the greatest Breadth of the Splay within, as $m\,l$, and side to l E, or n E, as before.

NOW, to find the Form of the Piece, that will exactly cover the Splay-back, take n E the Side of the Cone, and with that Radius describe an Arch of a Circle at pleasure, as $y\,a\,t$, Fig. V. on the Center w, wherein assign a Point (as at y) at pleasure; make the Length of the Arch $y\,a\,t$ equal to the Circumference of the Circle $m\,l$, the Base of the Cone, and draw the Lines $t\,w$ and $y\,w$; make $y\,x$ equal to $b\,d$, the Length of the Splay, and with the Radius $x\,w$ describe the Arch $x\,b\,v$; then is the Figure $y\,a\,t\,v\,b\,x$ the Piece required, which will exactly cover the whole Splay, as required: For, as the Sector $t\,w\,y\,a$ will cover the whole Cone, as before is demonstrated, therefore $y\,a\,t\,v\,b\,x$ will cover the Splay, which is a part. *Q. E. D.*

It

It is on this very Principle of covering a Cone, that all circular Mouldings laid on are worked:

As for EXAMPLE, *Let it be required to ſtick the Mouldings to the Baſe, or Cornice of a circular Pedeſtal,* as Fig. III. Plate CCCLXX.

(1) Make a Section, on Paper, of the Pedeſtal with its Mouldings, as in the Figure; continue the Face of their Projections inwards, until they meet on the central Line, ſo *lm* and *on*, being continued inwards, meet in the Point *k*: Now, if you conſider the Line *lo* as the Diameter, and the Lines *kl* and *ko* as the Sides of a Cone, the Mouldings are eaſily found, as follows; With the Radius *ko*, or *kl*, on a Point, as *e*, Fig. II. deſcribe the Arch of a Circle, as *hkl*, which make equal in Length to the Circumference of the Baſe of the Cone, and draw the Lines *el*, *ch*; make *gl* equal to *lm*, or *no*, and deſcribe the Arch *gdbf*; then is the Piece *hklfig* the Form and true Magnitude of the Piece, in which you are to work the Mouldings for the Baſe, and which will exactly finiſh, as required. The like is alſo to be obſerved in working of the Mouldings for the Cornice, as is evident by the Lines *ad* and *gf* being continued to *i*, and whoſe Piece is deſcribed by Fig. I.

To cut out the Lining to the Sofito of a ſemicircular-headed Door, or Window, ſtanding in a circular Wall, Fig. VI. Plate A, following Plate CCCLXIX.

Let DB*z*C repreſent the Plan of part of a circular Building, in which is placed a ſemicircular-headed Window with the *Splay-back*, as B*r*, or *z* 1, the Inſide of which is to be lined with ſlit Deal, *&c.* (1) Make a Plan of the Window, as in the Figure; continue on the Splays, until they meet on the Center Line, as at *a*; draw B*z* and *r* 1, on F deſcribe the Semicircle 1 2 3; divide the Quadrant *r* 2 into any Number of equal parts, (ſuppoſe 4) as at the Points 4, 5, 6, and from thence draw Right Lines parallel to the central Line A 2, until they meet the inward Line of the Building in the Points *t*, *w*, *x*, from whence draw Right Lines, parallel to B*z*, unto the *Splay-back* B*r*, as to the Points *s* A *v*: Now, if you ſuppoſe the Semicircle to be raiſed perpendicularly on its Diameter, and Lines drawn from every part of its Circumference to the Point *a*, they will form half a Cone; and if we ſuppoſe the Lines B*y*, *ſx*, A*w*, and *vt*, be raiſed perpendicular to the Plane of the Paper, then the Line B*r* is equal to the Length of that part of the Cone out of the Wall, that is perpendicularly over the Line *y*F; and ſo, in like manner, the Line *sr* is the Length over the Line *x*G, A*r* over *w*H, and *vr* over *t*I; this being done, on *a*, with the Radius *ar*, deſcribe an Arch, as *br*, which make equal to the Circumference of the Semicircle *r* 2 1, and divide it into double the Number of equal parts, as the Quadrant *r* 2 is divided into, *viz.* eight, as at the Points *c*, *e*, *g*, *k*, *m*, *o*, *p*, from whence draw Right Lines to the Center *a*; make *ki*, on the middle Diviſion, equal to B*r*; make *gh* and *ml* each equal to *sr*; make *ef* and *on* each equal to A*r*; make *cd* and *pq* each equal to *vr*, and thro' the Points *d*, *f*, *h*, *i*, *l*, *n*, *q*, trace the curved Line *bdfhilnqr*; make *b* 7, *d* 7, *f* 7, *h* 7, *i* 7, *l* 7, *n* 7, *q* 7, each equal to B*r*, and through the Points 7, 7, 7, *&c.* trace that Curve, then will the *Area*, included between theſe two Curves, and the Lines 7 *b* and B*r* be the Sofito, or Lining of the Splay required. Fig. VI. will be explained, when we come to ſpeak of finding the Centers of Pediments.

Of the Formation of Niches, Plate CCCLXIX.

Having now done with Doors and Windows, the next in Order is the Formation of *Niches, quaſi Nidi*, or *Neſts*, of old *Concha*, which are a Kind of

Pluteus, or ſmall Tribunals, and are ſo called by the *Italians* to this Day, wherein Statues are placed to protect them from the downright Injuries of the Weather. The magnificent Throne of *Solomon*, mentioned in 1 *Kings* x. 19. was undoubtedly a Niche, as the Words expreſs, *The Throne had 6 Steps, and the Top of the Throne was round behind*, &c. wherefore, as Mr. *Evelyn* obſerves, it ſeems to have been ſuch an ample *Niche*, in which a *principal* Perſon might ſit, as it were, half *canopy'd* over, within the Thickneſs of the Wall. Niches have their Receſſes, not only *ſemicircular*, as Figures *d* and *e*, Plate CCCLXVI. but are ſometimes made *ſemielliptical*, or *ſquare*, which laſt have their Depth equal to one third of their Diameter. They are in general uſed as Ornaments to enrich very large *Piers* between Windows, Columns, *&c.* and ſometimes to ſupply the Places of Windows. The *ſemicircular* Niches are the beſt for Statues, whoſe Height ſhould be equal to the Center of the Impoſt, or Center of the Head. If we would enrich their Heads, nothing is more natural and becoming than the *Eſculop*, whether printed or carved, or being divided into *ſquare*, *hexangular*, or *octangular* Pannels, proceeding from their Center, with Roſes of divers Kinds, as repreſented in the Inſides of *Cupola's*, Figures I, H, C, Plate CCCLXVII. But indeed Niches without Doors, ſhew beſt when plain, and therefore it is to be noted, that ſuch Enrichments are only proper for Niches within Doors, as at the End of a *Gallery*, *Hall*, *Church*, &c. *Elliptical* and *ſquare Niches* are moſt proper for Buſto's or Vaſes, as not being ſo deep as the *ſemicircular*, and which may be placed on a ſmall *Neck* or Pedeſtal, on a *Truſs* or *Mutule*, either plain or enriched with *Scrolls*, *Leaves*, &c (as the Occaſion requires.) When *Niches* are placed in the firſt Story, they muſt have Pedeſtals under them, as in Plate CCCLXIII. and Fig. *b* and *h* in Plate CCCLXVI; but when they are placed in a Range with Windows, they muſt be conformable to their Ornaments.

NICHES are made in four different Ways, as, *Firſt*, with plain Brickwork, rendered, and white-waſhed or painted within, or otherwiſe finiſhed with Ornaments of Plaiſter, called by the *Italians Stucco-work*. *Secondly*, With Stone, either plain or enriched. *Thirdly*, With Wood, as Wainſcot or Deal glued together painted: And *laſtly*, with wooden Quartering, lathed and plaiſtered. A ſemicircular or ſemielliptical Niche is compoſed of two parts; the lower one being one half of a Concave Cylinder, whoſe Baſe is a Semicircle, or Semiellipſis, and the other, one Quarter of a concave *Sphere*, or *Spheroid*, or *Semidome*. To make the cylindrical parts of both Kinds, is to do no more, than to raiſe them perpendicular over the curved Line of their Plans; but to form their upper parts is a Work ſomething more curious, as will appear by the following.

To make the Head of a Semicircular, or Semielliptical Niche, in rough Brick or Stone.

BEFORE theſe Niches can be made, there muſt be Centers made to turn them on, which, to do well, is a curious Piece of Workmanſhip, and may be done as follows.

I. *To make the Center for a ſemicircular-headed Niche.*

(1) MAKE a ſemicircular Plate, anſwerable to the Diameter of the Cylinder, on which the Feet of your Ribs muſt ſtand, like ſo many Rafters, as B, C, A, Fig. XV. Plate CCCLXIX. make the Front B D A exactly equal to the Plate B C A, which fix on B and A, at Right Angles to B C A; this done, cut out as many Ribs as are neceſſary, all which have the ſame Curve or Arch, as D A; then fix one on C, equal to B, or D A, (the Thickneſs of the Front at D excepted) and which will ſtand at Right Angles to B D A. Proceed in like Manner, to fit in all the others on each Side, making an Allowance for ſuch as muſt be cut away in their meeting together at D. Having thus prepared the Ribs, we muſt now proceed to the covering of them with ſlit Deal, which perform

form as follows, Fig. I. Plate CCCXCVII. Suppofe the upper Semicircle reprefent BDA, the Front of the Center in Plate CCCLXIX. on its Center erect a Perpendicular, terminating in *a*, which divide into any Number of equal parts, through which draw Right-lines parallel to the Diameter, as *e f*, &c. terminating at the Semicircle on each Side; on the Points, where thefe parallel Lines cut the Perpendicular *a*, defcribe Semicircles to terminate in the Extremes of thofe Lines, as in the Figure is reprefented: This being done, confider how many Pieces, and their Breadths, will beft fuit to cover the feveral Ribs, (fuppofe four) then divide one Quadrant of every Semicircle, as *l b*, *m e*, &c. into half as many parts, *viz.* two, as at the Points *o*, *n*, &c. continue out the Diameter *a l* to *c*, making *l c* equal to the Length of the Arch *a f b*; fet on the Line *l c*, from *l* to *k*, &c. the feveral Diftances, that the Extremes of the Semicircles are from one another, in the Quadrant *a b*, as *b e*, equal to *l k*, &c. and on the Point *c*, with the Radiufes *c l*, *c k*, &c. defcribe the Arches *h l d*, *i k g*, &c. and then making *l d*, *l h* each equal to half *l o*, alfo *k g*, *k i* each equal to half *m n*, and fo in like manner the other Arches between *k* and *c* equal to the Halves of all the other Arches of the Semicircles, being fo transferred, and lines being traced through all the feveral Points, as *h i*, &c. *c*, on the one Side, and *d g*, &c. *c*, on the other Side; then the Figure *h d c* will cover one quarter of the Head of the Niche, and, confequently, four of them will compleat the Whole; for, as the Length *l c* is equal to the Convexity *a b*, and as the feveral Curves *h l d*, *i k g*, &c. are equal to one 4th of the Semicircles, taken at their refpective parallel Heights, therefore the Figure *h d c* will cover one 4th of the Whole. *Q. E. D.*

BUT this Demonftration may be yet plainer underftood, if we imagine every of the Semicircles to be fo turned up on the Paper, their Diameters remaining fixed, as to cut it at Right-angles, parallel to the Diameter *b*; for then together they form one 4th of a Sphere, which is the Body, that the Center is to reprefent. Fig. II. is another Example of this Kind, for the Covering of a *fpheroidical Dome*, either on the conjugate Diameter *d b*, or on its tranfverfe *a e*; and altho' this Rule is given for covering of *Semidomes*, or *Niches*, and entire *Domes*, either *fpherical* or *fpheroidical*, yet it is alfo to be underftood for the Covering of the *Infide* of *Niches*, or *Domes*, with thin *Fineers*, &c. By this Rule Plumbers may cut out their Lead for to cover fuch Roofs with Certainty; but more of this will be faid, when I come to explain the Remainder of Plate CCCXCVII.

IN Plate CCCCVII. Figures M, N, Q, is a Method propofed for to cover the Head of a femicircular Niche, by Mr. *Francis Price*, in his *Treatife of Carpentry*; wherein 'tis to be obferved, that as the Ordnates *k* 1, 1 2, 2 3, &c. in the Line *k l*, Fig. M, are Right-lines, as alfo are their Parallels at *f f*, &c. and not circular and concentrick, as *h d*, *i g*, &c. in Fig. I. Pl. CCCXCVII. all the feveral parts in thofe Right-lines cannot be equidiftant from the Points *a a*, that is to fay, if the Line *a f*, Fig. M, which ftands over the Middle of 8 9, was to be continued, until it meet the Line 8 9, its Length would be lefs, than the Diftance taken from *a* to 8, or to 9, which fhould not be; for as the Point *a* reprefents the Vertex of a Dome, or Niche, and the Line 8 9 is fuppofed to be a part of its Bafe, 'tis certain, that every part thereof fhould be equidiftant from *a*, but they not being fo, this Method is falfe; as alfo is that of Mr. *Michael Hoar*, in his *Builders Pocket Companion*, whofe Method is reprefented alfo in Plate CCCCVII. Fig. V, T, wherein T is a fuppofed a Piece to cover part of the Whole: But here, as in Mr. *Price*'s, the Ordnates *f e*, *b a*, *n m*, &c. are all Right-lines, and parallel, which ought to have been circular, and concentrick, wherefore the Points *f* and *e* are at greater Diftance from *a*, than *w* is, which ought not to be, and therefore is abfurd alfo. The Reafon why I have inferted their Figures is, for the fake of demonftrating their Falfities, which are very evident, and therefore to be avoided; and which indeed, I believe both thefe Perfons were jealous of, as not having given any rational Account of their Method, to be underftood by any Reader.

As the *Covering* of the Ribs is thus taught, and ſuppoſed to be done, and the Center fixed in its place, proceed on with the Brick-work about it in circular courſes, which is beſt done with all *Headers*, breaking joint over each other, and which being placed with their true *Somering*, and key'd in well behind with broken Tyles, *&c.* the Whole will be completed as required. If it is required to make an entire *Dome* in Brick-work, it is to be obſerved, that every Courſe will key itſelf in, and therefore there never need be any *Center* made to turn them on, as muſt be done for a Niche; for if a Nail be fixed in the Center, and a Line ſtrain'd from it, it will ſhew the true Somering of every courſe; and a Lath being cut to the Semidiameter, and applied to the Center, will give the Diſtance of all its parts.

II. *To make the Center for a ſemielliptical-headed Niche.*

(1) MAKE fit a Plate to the Plan of the Niche, as Fig. XII. Pl. CCCLXIX. on which the ſeveral Ribs are to ſtand, and thereon aſſign their Places, as at r, q, , p, o, n, &c. (2) Cut on the front Curve, as B D A, Fig. XI. which muſt be equal to the Plate, and fix it at Right-angles, as in Fig. XI. the Rib D c e is a Semicircle; but the other Ribs, as i, h, g, f, and the like on the other Side, are Curves generated by ſuppoſed Sections of the Spheroid, cut thro' the Lines $r\,l$, $q\,l$, $p\,l$, $o\,l$, $n\,l$, Fig. XII. and which are all Quarter-parts of ſo many Ellipſiſes, that have the Lines $r\,l$, $q\,l$, $p\,l$, and $o\,l$, in Fig. XII. for one Half-part of their tranſverſe Diameters, to every of which the half conjugate Diameter $n\,l$ is common, and which may be deſcribed with a Trammel, as another Ellipſis, or geometrically, as in Fig. XIX. which contains a Demonſtration of their being ſo many Ellipſiſes.

Let 6 y 5 be the Plan of a ſemielliptical Niche, and 'tis required to find the Curvature of a Rib, ſtanding over the Line a q, which is taken at pleaſure.

DIVIDE $a\,q$ into any Number of equal parts, (ſuppoſe 6) as at the Points n, m, i, e, c; through which draw Lines, *firſt*, parallel to $q\,y$, *ſecondly*, parallel to 6 q, and, *laſtly*, at Right-angles to itſelf, of length at pleaſure. Now, if we ſuppoſe that Sections are made, through the Quarter-ſpheroid, at the Lines $z\,p$, 7 1, 8 2, 9 3, 10 4, and $q\,y$, 'tis evident that every ſuch Section would be a Quadrant, as z 11 p, whoſe Arch cuts the Perpendicular $c\,b$ in the Point b. In like manner the Line 7 1, being made Radius, and turned upon the Center 7, it will cut its Perpendicular $e\,h$ in h; ſo likewiſe will

The Line $\left\{\begin{matrix} 8 & 2 \\ 9 & 3 \\ 10 & 4 \end{matrix}\right\}$ being made Radius, cut its Perpendicular $\left\{\begin{matrix} i & k \\ m & l \\ n & r \end{matrix}\right\}$ in the Point $\left\{\begin{matrix} k \\ l \\ r \end{matrix}\right.$

Make $\left\{\begin{matrix} c & r \\ e & s \\ i & t \\ m & v \\ n & w \\ q & f \end{matrix}\right\}$ equal to $\left\{\begin{matrix} c & b \\ e & h \\ i & k \\ m & l \\ n & r \\ q & y \end{matrix}\right\}$ and through the Points r, s, t, v, w, f, trace the Curve, which is the Rib required: For as the Points b, h, k, l, r, are the real Interſections of the Semicircles on every Section, and the Lines $c\,b$, $e\,h$, $i\,k$, $m\,l$, and $n\,r$, $c\,r$, $e\,s$, $i\,t$, $m\,v$, $n\,w$, are real Perpendiculars from the Line $a\,q$, which meet thoſe Semicircles over the Line $a\,q$, therefore the Curve $f\,w\,v\,t\,s\,r\,a$ is the Curve of the Rib required, and ſo in like manner any other.

NOW it is to be here obſerved, that as all Sections of a *Sphere*, that paſs through its Center, are Circles, ſo alſo all Sections of a *Spheroid*, made thro' its Center, are Ellipſiſes; and therefore Ellipſiſes may be generated three different Ways, *viz.* by the Section of a *Cone*, a *Cylinder*, and a *Spheroid*.

THE Nature and Manner of deſcribing of the Ribs being thus made eaſy, as alſo their Covering, the Making of Centers for Brick or Stone-work is from thence taught, as alſo is the Making of Niches with Lath and Plaiſter; for when the Ribs are cut out, and fixed up, they are very eaſily lathed and plaiſtered. The ſeveral Curves V, W, X, Y, Z, Fig. IX. Plate CCCLXIX. are the Ribs proper to ſtand over the Lines $w\,g$, $m\,g$, $l\,g$, $k\,g$, and $i\,g$, in the Plan T. The moſt curious Performances, that are made in the Heads of Niches, are

are to make them in rubbed and gaged Brick-work, an Example of which (and the very beſt I have ſeen) is a Niche in the Gardens of the Right Honourable the *Earl of Strafford*, at *Twickenham*, in the County of *Middleſex*, which contains ten Feet in Diameter, made by the ingenious *John Gregory*, deceaſed, to whoſe Memory this Niche, and ſome *curious Brick-work* in the Chancel-end of that Pariſh-church, will be laſting Monuments.

THE beſt Way of performing theſe Works is, (1) to have the Center made with great Exactneſs; (2) to ſtrike out thereon every Courſe, from its Front to its Center behind, with every Joint, which muſt be concentrick thereto. If the Head is *ſpherical*, then making Templets, or Moulds to the firſt two Courſes will be ſufficient for the Whole, the Curvature being equal; but if it is *elliptical*, then there muſt be Templets made to every Courſe contained in one half part, becauſe the Curvature of every Courſe therein is different: This done, and the *Somering* of every Courſe being truly kept, the Whole may be completed with Beauty and Delight.

THE next and laſt Method is by the Thickneſſes of Boards or Planks, as follows.

I. *To make a ſemicircular-headed Niche, by Thickneſs of Boards, Plank,* &c. Fig. XIV. Plate CCCLXIX.

(1) LET the Semicircle ADB repreſent the Face of the Niche, whoſe Height is *e* D, which divide into ſuch equal parts, as will be agreeable to the Thickneſs of the Boards, or Plank, and through thoſe parts draw Lines parallel to BA, as the pricked Lines in the Figure. This being prepared on a Board, or Wall, take your firſt Board or Plank, and on a Center choſen on its Edge, with the Radius 1 2, deſcribe a Semicircle, which will be equal to the Front BDA; apply a Square to the Center, and draw a Line on the Edge to the other Side to find the Center there, whereon, with the Radius 3 4, deſcribe another Semicircle; then, with a *turning Saw*, cut through from the under to the upper Semicircle, and your firſt Thickneſs is made. (2) Take the Piece intended for the ſecond Thickneſs, and on its Edge aſſign a Center, whereon deſcribe a Semicircle equal to the laſt, (becauſe the under part of this ſecond Thickneſs muſt fit on the upper part of the firſt, and therefore muſt be equal to it) then ſquare off the Center on the Edge to the upper Side, whereon, with the Radius 5 6, deſcribe another Semicircle, and, with a turning Saw, cut through all round to the other Semicircle, as before, and thus is your ſecond Thickneſs done. Proceed on in like manner with all the others, always obſerving to make the under Semicircle of every Piece equal to the upper one of the Piece next under it, until all are done, and which being well glewed together, and dry, clear off the Whole with a circular ſmoothing Plane, whoſe Curve is part of a Circle of a ſomething leſs Diameter, than that of the Niche.

II. *To make a ſemielliptical-headed Niche, by Thickneſs of Plank, or Boards.*

TO perform this there is no Difference from the foregoing; for, as there you divided the Height into equal parts, agreeable to the Thickneſs of the Boards, or Plank, and, thro' thoſe Diviſions, drew Right-lines parallel to the Baſe or Diameter, whoſe Lengths determined the Radius of every Semicircle on each Piece, ſo here, the Height being divided in like manner, and Lines drawn from the ſame Points, as well parallel to its ſemiconjugate, as ſemitranſverſe Diameters, to find the Semidiameters of both Kinds, Ellipſiſes are deſcribed on each Piece, which diminiſh as the Semicircles, and whoſe Diameters are found as follows.

LET CBA, Fig. XIII. repreſent the elliptical Niche required; make *p g o*, Fig. XVIII. equal to half CBA, that is, to 1 BA; alſo make *n m l*, Fig. XVII. equal to the Depth and Height of CBA, which, in plain Terms, is its Section. And as *n m*, Fig. XVII. is equal to *p g*, Fig. XVIII. they both repreſenting the

the Height of the Niche, therefore divide each of them into the ſame Number of equal parts, and from thoſe parts draw Lines parallel to *ml* and *go*; then will the Parallels in Fig. XVIII. be ſemitranſverſe Diameters, and the Parallels in Fig. XVII. will be ſemiconjugate Diameters of the ſeveral Ellipſiſes to be deſcribed on each Thickneſs, as the Semicircles aforeſaid, and which being done will compleat this, or any elliptical-headed *Niche*, as required.

Plate CCCLXXI. *The Butments of Arches to Doors, Windows, and Niches demonſtrated.*

ALL Arches to the Heads of Doors, Windows, or Niches, are either ſimple or compound. Simple Arches are thoſe which contain a Semicircle, as Fig. B, or a part of a Semicircle, as Fig. A, which laſt is called a ſcheme Arch. If a ſemicircular Arch be divided into 4 equal parts, the two outer parts are called *Hanſes*, and the two middle parts taken together are called its *Scheme*; and Lines drawn from the Center to the Terminations of the Scheme will meet each other in an Angle of 90 deg. Now, if, from the inner and outer Points of the Scheme, where theſe two Lines cut the inward and outward Arches, Right-lines be drawn at Right-angles to thoſe Lines, and continued, until they meet the Diameter of the Semicircle, (being continued out on both Sides) they will be the true Butments to ſuch an Arch, becauſe the Thruſt of the Scheme on both Sides is receiv'd directly at Right-angles, which, being ſtronger, than any acute or obtuſe Angle, is therefore the true Butment required. And if the Materials of ſuch Butments are ſtrong and durable, and the Baſe, or Foundation, on which ſuch an Arch is placed, be very firm and ſound, there cannot be any Weight placed on its Key-ſtone, that can break it down. If we encreaſe the Scheme, and leſſen the Hanſes, as is repreſented by the lower dotted Lines, 'tis plain, that it requires a leſs Butment, than the former, as being nearer to its Baſe; but as the Scheme is encreaſed in its Curve, 'tis weakened alſo, as being liable to fly out at 45 deg. Diſtance from the Middle of its Key-ſtone, where the Thruſt is made at Right-angles, and received by this left Butment at Acute-angles, which are weaker than Right angles, and therefore an Arch ſo built muſt be loaded diſcretionally, leſt it come down, as many daily do, to the Shame of their Builders, and Loſs of many Lives.

FIG. A repreſents a Scheme Arch with its Butments at Right-angles to the *Skew backs*, which, being continued in ſolid Work, as low as the Center of the Arch, (or rather a little lower) is the Butment required. The flatter an Arch is made, the greater is the Thruſt, and the higher, the leſs, againſt its Butments; which is very evident by Figures D and C, where the firſt is a Semiellipſis, whoſe Scheme being very long and low, its Butments, at Right angles to its Extreams, require a very great Extent; whereas the ſecond, which is a compound Arch, and generally called *Gothick*, is very high, and hath its Butments very near. *N. B.* The Lines, which terminate the *Hanſes*, and from which the Butments proceed at Right-angles, are drawn from the Center of each Arch, at 45 deg. Diſtance from the Angle at the Key-ſtone.

THUS much with reſpect to ſimple and compound Arches, which in general are of equal Strength, if their true Butments at Right-angles to their Schemes, at 45 deg. Diſtance, be made firm, and of ſound Materials, and which cannot be broke down by any Weight whatſoever, until they are cruſhed by the Power of Weight, or torn to pieces by the hungry Teeth of Time.

NOW, what has been ſaid hitherto, has been conſidered with reſpect to Weight being laid on the Schemes only, without any Regard being had to the Weight on the Hanſes, which in many Caſes are compelled to do the Office of real Butments, and, indeed, are oftentimes all the Butments, that can be had. Now, to know what Weight muſt be laid on each Butment is very eaſy, becauſe that Action and Reaction are equal; therefore 'tis evident, that if the Weights on the two Butments are ſuperior to the Weight of the Scheme, it cannot thruſt them away,

away, and the Arch will ſtand ; but if the reſiſting Weight of the Hanches be leſs, than the thruſting Weight of the Scheme, then the Scheme will inevitably fall, and which is the Caſe very often, when obſtinate and ignorant Bricklayers will ſtrike the Centers of ſemicircular Arches, before they have ſo brought up the Work over the Hanches, that the Weight thereof be ſuperior to the Thruſt of the Scheme.

Plate CCCLXXII. *The Manner of framing Naked Flooring.*

BEFORE that a Floor can be began to be framed, there muſt be a Plan of the Building made, that thereby we may form a Judgment, where to place the Girders in the moſt ſubſtantial Manner ; and indeed this ſhould be done, before the Brick-work is raiſed high enough to receive them, that not only the Lintels may be well placed over Doors and Windows, (which ought never to be leſs, than five by ſeven Inches) but in thoſe Places, on which the Ends of the Girders are to reſt ; which Lintels, or Bearing-pieces, being made equal in Length to the Diſtance that is contained between Girder and Girder, will communicate the Weight equally on the whole Wall, and which is much better, than when the Bearing is on the parts juſt underneath them only, as is the Caſe, when Lintels are not uſed ſo; and beſides, when Lintels of ſuch Lengths are ſo laid, and contain 4, 5, 6, or 7 Inches in Thickneſs, according to the Thickneſs of the Walls, they are very great Strengthenings, and tie thoſe parts very firmly together, wherefore they are called *Bond Timbers* ; but leſt Bond Timbers be not perfectly underſtood, I muſt alſo obſerve, that Bond Timber is to be laid in Walls wherein no Girders are, as in End-walls, Croſs-walls, *&c.* and which, being laid throughout all ſuch Walls, at every 6 or 7 Feet in Height, and being dove-tail'd, or cogg'd together at every outward Angle of the Building, as P O, and at every Party-wall, as S T, or V W, in Plate CCCLXXV. will moſt firmly bind the Whole together, ſo that, even if a Foundation be unfirm, they will oblige the Settlement to be regular, and prevent Cracks and Fractures, that would be, if ſuch were neglected. But before I proceed any further, I muſt beg leave to obſerve, that neither the double Dove-tail at S, or treble Dove-tail at V, are ſo ſtrong, as the ſingle Dove-tail at O. Thus much by Leave of this Maſter.

IT is a Matter of Diſpute among Workmen, which is the beſt Way of placing the Ends of Girders, on ſtrong Lintels, or Breaſt Sommers, over the Heads of Windows, or in the Piers between them ; for certain it is, that when the End of a Girder is decayed, that is placed over a Window, if the Head of the Window be ſhored up, whilſt the Lintel is taken out, a new Girder put, and the Lintel put in and fixed in its Place, no part of the Brick-work is injured ; whereas, when a Girder laid into a Pier of Brick-work is decayed, to take it out, and put another in, doth generally make a very great Fracture, and, where the Pier is very narrow, doth very greatly endanger it. The turning of ſmall Arches over the Ends of Girders is an excellent Method, becauſe then they may be taken out, and put in again at pleaſure without Prejudice to the Building.

THE Figure O N M is the Plan of a ſuppoſed Building, wherein the dotted Lines expreſs the Situations of the Girders, which have all ſolid Bearings on the Walls, and which are ſo laid, (and are always to be obſerved) as that the Boards lie all one Way through the Middle of the Building, as from O to M, becauſe the whole Breadth may be ſeen at one Time, either from the Point O, or the Point M ; and if the Joints of the Floor of one Room were not ranged the ſame Way, as the Joints of the other, they would have a very ill Effect. The Figures V R, T Q, and S P, repreſent the Joiſts framed into the Girders aforeſaid, of which more will be ſaid in its Place. The Situation of Girders being determined in the Plan, we are thereby taught to find their Lengths, their Number, and their Diſtance, which ſhould never exceed 12 Feet in any Building whatſoever ; nor ſhould Joiſts exceed that Length. It is

 alſo

alfo to be obferved in the placing of Girders, always to lay them the fhorteft way, and that their Ends have at leaft 14 Inches Bearing in the Wall, excepting thofe in very fmall Buildings, where Walls are of thin Dimenfion, then their Bearing may be reduced to 10 Inches. As nothing is a greater Enemy to Timber than Lime, 'tis beft to lay the Ends of Girders in Loam; and Lintelling, and other Bond Timber (efpecially that of Fir) is beft preferved by being anointed over with melted Pitch and Greafe, of which the laft to be a fifth part, *viz.* to four Pounds of Pitch put one Pound of Greafe.

It being neceffary that Scantlings of Girders fhould be of fufficient Strength, according to their Lengths, I fhall therefore deliver them, 1*ft*, as appointed by Parliament, for the Rebuilding of the City of *London*, juft after its being reduced to Afhes; and, 2*dly*, according to the prefent Practice in our modern Buildings.

(1) If the Length of a Girder be from … to … then its Scantling muft be … by … Inches

Feet		Feet		Inch.		
10	to	15		11	by	8
15		18		13		9
18		21		14		10
21		24		16		12
24		26		17		12

(2) If the Length of a Girder of Fir be … then its Scantlings muft be … by … Inches.

Feet	Inch.		
10	8	by	10
12	8½		10
14	9		10½
16	9½		10½
18	10		11
20	11		12
22	11½		13
24	12		14

But as Timber is very different in its Strength, it is not poffible to affign certain Scantlings, and therefore they are to be varied at the Difcretion of the *Carpenter*. It is alfo to be obferved, that altho' Oak is much ftronger than Fir, yet as it is of a greater fpecifick Gravity, it muft therefore have larger Scantlings for the fame Purpofes, than Fir, which is weaker. The laft Scantlings are given by Mr. *Smith*, and the following by Mr. *Price*, wherein you'll fee, at one View, their Differences.

(1) If a Girder of Fir in a fmall Building be … in Length, then its Scantling muft be … by … Inches.

Feet	Inch.		
16	8	by	11
20	10		12½
24	12		14

But if of Oak, then the Scantling muft be … by … Inches.

10	by	13
12		14
14		15

(2) If a Girder of Fir in a large Building be … in Length, than its Scantling muft be … by … Inches.

Feet	Inch.		
16	9½	by	13
20	12		14
24	13½		15

But if of Oak, then the Scantling muft be … by … Inches.

12	by	14
15		15
18		16

Now, fince of all the Scantlings given here, not any of them are perfectly fquare; therefore, in every of them, let the fmalleft Dimenfions be underftood, as the Horizontal Surfaces, and the greateft, the upright Sides. For by Experience 'tis evident, that that Weight which will juft break down a ten Foot Deal, bearing on its Ends only, with its Breadth parallel to the Horizon, cannot bend it, when it's placed with its Breadth perpendicular to the Horizon. As Girders are fubject to the Weight they fupport, as well as to

to their own Weight, they do therefore in Time give way to ſuch Force, and bend downwards (called *Sagging*) if not prevented; wherefore 'tis uſual to cut them *Camber*, that is, to cut them with an Angle in the Midſt of their under Surface, as Fig. B, Plate CCCLXXV. and Fig. *z*, Plate CCCLXXXII. which Angle muſt riſe above the Horizontal Line, 1 half an Inch for every 10 Feet that the Girder is in Length. But as this Expedient will not do in Girders of great Lengths, they are alſo truſs'd up within-ſide in Manner following.

The Manner of truſſing Girders. Plates CCCLXXV. *and* CCCLXXXII.

THE Figures A, C, D, E, F, G, H, I, in Plate CCCLXXV. are Methods propoſed by Mr. *Smith*; and thoſe of Plate CCCLXXXII. by Mr. *Price*, which are perform'd as follows. (1) Saw the Girder down the Middle the deepeſt Way, and having prepared two Pieces of dry Oak, about four by three Inches, or ſix by four Inches, as the Strength of the Girder may require; let half of the Thickneſs of one Piece into one of the inward Sides, as in *g*, Plate CCCLXXXII. at *m l*, as tight as its poſſible to drive them in; and having cut out the Cavities in the Piece *h*, fitting to receive the other half parts of the Truſſes, drive it on as tight as is poſſible, and then, the two Pieces of the Girder being well bolted together, 'tis made fit for Uſe. The Girder *r q p o* hath its Truſſes, each equal to one 3d of the Girder's Length; and if at *q* and *p* you mortiſe down through both Fletches, and therein drive Wedges, you may, when the Building is cover'd in, tighten the Truſſes at Pleaſure. The Truſs Figure G, Plate CCCLXXV. is alſo tighten'd by a Wedge driven through at *c d*, having beforehand cut out, within-ſide of the Fletches, a free Paſſage for the Wedge; both theſe laſt Methods, I eſteem to be the very beſt of all the various Ways, propoſed in the ſeveral Figures of theſe two Plates.

Leon Baptiſta Alberti taught the ſlitting of Girders, and reverſing of the Fletches (being well dryed) without any truſſing, and ſo bolted the Top of one Fletch againſt the Butt of the other, as Fig. *k*, Plate CCCLXXXII; and which in many Caſes I believe to be an excellent Method.

IN the Choice of Timber for Girders, great Care ſhould be taken to have it as free from Knots as is poſſible; becauſe thoſe parts are more ſubject to break, and to early decay, than any other. The Figure *u y w* repreſents how Timber may be uſed, when two ſhort of itſelf, for the Purpoſe required; that is, ſuppoſe the Piece *w s*, ſhould have extended, or reached further than its End *x*, and no longer Piece can be had; in any part towards the End, mortiſe and tenon in the Piece *t* at *w*, alſo at *x* mortiſe on the Piece *v*, but obliquely, not at Right Angles, which alſo tenon into the Piece *t* at *y*; then will the Ends of the two Pieces *u* and *t* become Bearings for the Piece *s*, at a greater Length than itſelf could extend to.

HAVING thus largely explained the Situation, Scantlings, and Truſſing of Girders, we may now proceed to the Joiſts, which are of various Kinds, *viz. Common Joiſts, Trimming Joiſts, Binding Joiſts, Bridging Joiſts*, and *Cieling Joiſts*.

(1) *Common Joiſts*, are thoſe repreſented in Fig. A, Plate CCCLXXII. and at SP and VR in Plate CCCLXXXII. which are framed fluſh (that is, level) with the upper Surface of the Girders, and which ſometimes are all of equal Depth, but leſs than the Depth of the Girder, whereby the Girder becomes lower than the Cieling: But the moſt genteel Way is, to have every third or fourth Joiſt, equal in Depth with the Girder, whilſt the other intermediate Joiſts are of leſs Depths, and between thoſe deep Joiſts fix ſmall Joiſts to carry the Cieling, which then will conceal the under Surfaces of the Girders, that otherwiſe have an ill Effect.

(2) *Trim-*

(2) *Trimming Joists* are such as are framed into other Joists, for other Joists to be framed into them, which are against a Chimney, as *a* in Fig. A. Plate CCCLXXII. or to give Way for a Stair-case, as represented on the left. Now as these Joists are weakened by receiving many Mortises, and being to sustain the Weight of many Joists bearing in them, they are therefore made of greater Scantlings than common Joists.

THE Scantlings of Common Joists and Trimming Joists framed, as Fig. A. may be as follows.

If the Length of the Common Joist be (Feet)	the Breadth must be (Inches)	and Thickness (Inches)
5	7	2 ¼
6	7	2 ½
8	7	2 ¾
9	8	3
10	8	3 ¼
11	8	3 ½
12	9	4

If the Length of the Trimming Joist be	then its Scantling must be	and
5	7	3
6	7	4
7	7	5
8	8	4
9	8	5
10	9	6

THESE are the Scantlings given by Mr. *Smith*, and the following are by Mr. *Price*.

(1) If the Length of Fir Joists for small Buildings be (Feet)	then the Scantling must be (Inches)
6	5 by 2 ½
9	6 ½ by 2 ½
12	8 by 2 ½

But if the Joist be of Oak, then the Scantling must be	
	5 by 3
	7 ½ by 3
	10 by 3

(2) If the Length of Fir Joists for large Buildings be (Feet)	then the Scantling must be
6	5 by 3
9	7 ½ by 3
12	10 by 3

But if the Joist be of Oak, then the Scantling must be	
	6 by 3
	9 by 3
	12 by 3

(3) BINDING JOISTS are those, on which *Bridging Joists* are laid, and in which the *Cieling Joists* are framed, as the six Joists marked *b b*, &c. in Fig. B, Plate CCCLXXII. These Joists are framed flush with the under Surface, and about three or four Inches below the upper Surface of the Girders, that thereby they may receive the Cieling Joists flush with the under Surface, and sustain the Bridgings flush with the upper Surface also. Their Distance from each other is from three Feet to ten Feet, and their Thickness in Proportion to the Length of their Bearing.

(1) If Bridgings of Fir in small Buildings have	Feet Bearing, their Scantlings must be (Inches)
6	4 by 2 ½
8	5 ½ by 2 ¼
10	6 by 3

But if of Oak, then the Scantlings must be	
	4 by 3
	5 ½ by 3
	7 by 3

(2) If

			Inches.
(2) If Bridgings of Fir in large Buildings have	6, 8, 10	Feet Bearing, their Scantlings must be	4 by 3; 5 ½ by 3; 7 by 3
But if of Oak, then the Scantling must be			5 by 3 ½; 6 ½ by 3 ½; 8 by 3 ½

THE Figures K and L, in Plate CCCLXXXII. is the Manner of proportioning of their Tenons and Mortises, by Mr. *Price*, and which I look upon to be a much better Kind of Tenon, than any of the eight Kinds, shewed by Mr. *Smith*, at the bottom of Plate CCCLXXII. *Note*, That all binding Joists ought to be half as thick again as common Joists; therefore, if common Joists are three Inches thick, a binding Joist should be four Inches and a half, altho' the same Depth.

(4) BRIDGINGS, or *Bridging Joists* are represented by those marked *m m*, &c. in Plate CCCLXXII. lying on the binding Joists, as *b*, and which are also represented in Fig. T, Q, Plate CCCLXXXII. wherein *a* and *b* represents the Sections of two binding Joists, and which, to be easily understood, must be so turned, as to invert the Letters bottom upwards, the Figure being wrongly placed by the Engraver; and which being done, then *c d* shews the Situation of a bridging Joist on those binding Joists, and *f*, which is a Cieling Joist, exhibits the Manner of their Reception by the binding Joist. The Section over V exhibits the Manner of fixing Cieling Joists between deep Joists, where shallow ones, as *p*, *o*, *n*, are framed in between them, as I observed, to be the most genteel Way of framing Common Joists.

THE Distance of Bridgings is generally about 12 or 14 Inches, and their Scantlings about 3 by 4 Inches, or 3 and a half by 5 Inches.

THEIR Bearing is never more than the Intervals of the binding Joists, which is from 3 Feet to 10 Feet, and which are laid even, or flush with the Girders, (as aforesaid) to receive the Boarding.

(4) CIELING Joists, the most slender of all other Kinds of Joists, as having the least Weight to support, are made about 2 Inches by 3 Inches, or 3 by 4 Inches, according to the Strength of the Building. These are represented in Plate CCCLXXII. by those marked *n n*, &c. whose Distances are generally at 12 or 14 Inches. These Joists (as I observed before) are tenon'd into the binding Joists, as represented by the Section *k i b*, over S, in Pl. CCCLXXXII. where *b* represents a single Mortise, made on the one Side of a binding Joist, and *i* and *k* two double Mortises, called *Pully Mortises*, in the Side of a parallel binding Joist, to receive the other End of the Cieling Joist. These *Cieling Joists* and *Bridgings* are seldom fixed, until the House is covered in, when the last are pinned down to the binding Joists. These Kinds of Floors are called *Bridging Floors*, and are the best Kind of *Carcase Flooring*.

N. B. THE upper Figure in Plate CCCLXXIII. represents a pretty Device, by *Sebastian Serlio*, *How to frame a Floor by the Help of very short Pieces*, which I have given here for the Amusement of the young Student.

Plate CCCLXXIII. *The Manner of framing Timber Partitions.*

THE Examples given for this Kind of Work are *three* by Mr. *Smith*, in Plate CCCLXXIII. and *seven* by Mr. *Price*, in Plate CCCLXXXIII. (1) Those by Mr. *Smith*, of which the upper one is framed in the common Way, and wherein I think are more Mortises and Tenons, than need to be; for were the Braces to be let into the principal Posts, so as to butt against Shoulders of about half an Inch in Depth, and nailed in, they would do the same Office in a much more able Manner, than being tenoned in, (as here represented) and would be done in less than half the Time; and as the *Quarters* are only to sustain the

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Lath and Plaifter, &c. the Weight of the Roof, &c. being carried by the Pofts and Plates, they have no Need of being framed into the upper and under Plates, which takes up much Time, and will not endure longer, than when they are cut and nailed in only, and which is done with very little Time and Expence. The middle Example AA, its Author fuppofes to be for a Warehoufe, &c. where Girders, or fome other Weight are to reft on the King-pofts A, A, &c. but furely he means that, when under the Pofts A, A, there are Windows, or bad Foundation, that cannot fuftain the Weight laid on A, A, and therefore muft be difcharged by the Struts to bear on the bottoms of the intermediate Pofts, and which, on fuch Occafions, is an excellent Method; but where the Weight may be impreffed equally throughout the whole Length, then this Kind of framing is to be avoided, as being very expenfive in Wafte of Timber to cut out the Joggles of the King-pofts, much Time to its framing, and at laft to no other Purpofe, than the Work of the upper Example will perform, which is full as ftrong, and much cheaper, both in Timber and Time.

THE Example, Fig. E, is propofed to rife the Height of two Stories, the lower of 13 Feet, the upper of 12 Feet, or otherwife in one Height only, as the Side of an Out-houfe, Barn, &c. more properly than of a Hall, or Salloon, as our Author fuppofes. Now it is to be obferved, that as Joifts are fuppofed to lye on the *Inter-ties* (which is the middle horizontal Piece againft D, and) which is framed into the King-poft and outward principal Pofts, the whole Weight, at each End, muft depend on the Strength of the Tenons, excepting fuch Aid, as is given to it by the under Quarters; wherefore I am of Opinion, that the lower Braces are placed exactly the wrong Way, becaufe they now fupport the Inter-tie near to where they are fupported by the middle Pofts, and where they do not ftand in any Need; whereas, were their Ends turned, to affift next to the bearing Tenons, the Inter-ties would be made very fecure, and they would, at the fame Time, perform their Office of bracing, &c. As to the King-poft at E, on which he fuppofes a Girder, or Beam of the Roof to be placed, I muft own, I cannot fee any Occafion for fuch Wafte of Timber in cutting out the Joggles; for if fuch Pofts were made a fmall matter more in Breadth, and their Struts let into them with fmall Shoulders, commonly called by Workmen *Birds-mouths*, they would be as ftrong and fecure, as they can be done this way.

THE Examples given by Mr. *Price*, Plate CCCLXXXIII. come next in Order, of which Figure V is the firft, which he fuppofes to be a Partition between two Rooms, wherein Doors are required next the Extreams, and therefore has placed a King-poft in the Middle, with Prick-pofts between it and the Doors. It is here to be noted, That the middle horizontal Piece, which is called the *Inter-tie*, is halved, not only into the Prick-pofts, but even into the King-poft alfo, which is a great Weakening to it, therefore abfurd; nor indeed is there any Need for any *Inter-tie* at all, if the Height is intended but for one Story: And, admit there was an Occafion for it, would not its being flightly tenoned into the King-poft have been a lefs Weakening to it, and, to have given it a ftrong Bearing, to have turned the lower Struts the contrary way? The halving of Timbers together I know to be a common Method, but fhould never be done but with very great Judgment, and always avoided in Braces and Struts.

FIG. D is his fecond Example, and which is a very ftrong Method, wherein three Doors are fuppofed, and wherein the two King-pofts, and Inter-tie are halved as before.

FIG. E is his third Example with a Door in the middle, and which is a good Defign, as alfo is his fourth Example, Fig. X. wherein the Inter-tie is halved into the Pofts as aforefaid.

FIG. C is alfo a very ftrong Method of framing, but is very expenfive.

FIG. B is a Partition fuppofed to fuftain a Gutter, common to two Roofs, with their Beams and Rafters, or to carry a Wall of Brick or Stone.

LASTLY, The Figure A reprefents the Manner of a Timber Front, with an

an Arcade in its lower Story, whoſe Poſts being placed on reverſed Arches of Brickwork, cauſes the Weight on thoſe Poſts to be impreſſed as well on the Foundation between, as directly under them. *Note*, All theſe ſeven Examples, are, by the Miſtake of the Engraver, inverted, therefore, to rightly view them, you muſt turn the Book upſide down.

THE proper Scantlings of principal Poſts, given by Mr. *Price*, are as follows, *viz.*

I. *For ſmall Buildings*,

Fir Poſts of	8, 10, 12	Feet in Height to be	4, 5, 6	Inches ſquare.
Oak Poſts of	10, 12, 14	Feet in Height to be	6, 8, 10	Inches ſquare.

II. *For large Buildings.*

Fir Poſts of	8, 12, 16	Feet in Height to be	5, 8, 10	Inches ſquare.
Oak Poſts of	8, 12, 16	Feet in Height to be	8, 12, 16	Inches ſquare.

NOW, though all the Scantlings given here are ſquare, yet it is to be underſtood, that we are not compelled to make them ſo, though, perhaps 'tis neceſſary, we ſhould keep up to their Strength; and therefore, as Mr. *Price* obſerves, if conveniency will not admit us to make a Poſt, for Example, 6 inch. ſquare, whoſe Baſe is equal to 36 inch. yet 'tis likely we can make one 9 inch. by 4 inch. *&c.* whoſe Baſe is equal to 36, as the other, and its Strength I believe equal alſo, and ſo in like manner all others.

Plate CCCLXXIV. *The ancient Manner of Framing the Timber Fronts of Buildings.*

WE may very reaſonably believe, that, when Buildings were framed as repreſented by the lower Figure, there was a greater Plenty of Timber in *England*, than is at preſent; and, as I have in the preceding demonſtrated the modern Manner of Framing, I thought it not amiſs to compare it with the ancient Manner, and to give my *Readers* an Account of the Names of the ſeveral parts, which are number'd, and whoſe Names in the Plate ſtand againſt the reſpective Figures.

Plate CCCLXXV. *Divers Methods for truſſing Girders, and ſcarfing or piecing of Timber together.*

THE Manner of Truſſing Girders being explained in Plate CCCLXXII. it need not be repeated. The Manner of ſcarfing Timber together is repreſented by Fig. K, L, M, N, as alſo in Plate CCCLXXXII. where the Joints *a* and *b* are for *Plates*, Lintels, or Timber for Ties, and, if for Beams to a Roof, add the Bolts and Screws, as repreſented in the Figures. In Works where much Strength is required, the other Fig. *c*, *d*, *e*, *f*, may be conſulted; and when it happens that the Length of Timbers cannot be abated, then Fig. *f* muſt be the Joint, and that of *e* for an extraordinary Uſe, for, by its being in two Thickneſſes, it is made as ſtrong as though it were an entire Piece. *Note*, In forming of Ground, or raiſing *Plates* to Timber Fronts, that their Joints be ſo contrived, as never to be in the Breadths aſſigned for Doors or Windows, but always in the intermediate parts between them.

As

As I am now come to the Formation of Roofs, of which the aforefaid *Plates* are a part, as being the Bafe on which the Beams lie, and fmall Rafters ftand, we muft (after having formed it to the Plan of the Building, and fecured its Angles, in the Manner reprefented by Fig. OPQ, Plate CCCLXXV.) confider of the proper Diftances and Places to lay the Beams on, wherein obferve, (1) To avoid the Joints of the *Plate*. (2) That their Diftance be not too great, left you are obliged to have large *Cieling* Joifts, and large Purlins, which are but a Load to a Building, and therefore fhould not exceed 10 Feet. (3) That they lie over, or nearly over, the Heads of the *principal Pofts* in Timber Buildings, and on *Piers* of Brick or Stone Buildings.

THEIR Situations and Lengths being determined, their under Surface at each End, being equal to the breadth of the *Plate*, is dove-tail'd an Inch and half or 2 Inches in depth, according to their Strength, and which are let into both *Plates*, as the Pieces T and W into the *Plates* S, V, Plate CCCLXXV. but, as I have obferved already, with one fingle Dove-tail, not double, or treble, as are here reprefented as abfurd Rarities by Mr. *Smith*. If the breadth of the Beam be divided into 3 parts, give the middle one to the breadth of the narrow part of the Dove-tail, which opens to the whole breadth at the End of the Beam. When Beams are thus dove-tail'd into the *Plates*, they are then faid (by Workmen) to be cogg'd down, and ready to receive their *Ceiling* Joifts, and principal Rafters.

BUT before the principal Rafters can be framed, the Height of the Pitch, and their Length muft be determined.

THE Pitch of every Roof muft have refpect to its *Covering*, whether it be of *Lead*, *Pan-tile*, *plain Tile*, or *Slate*, and which (except *Weather-boarding*, *Shingles*, and *Thatch*) I think, are all the *Covering* we have in *England*.

THE ufual Pitches made ufe of are Pediment Pitch, Common Pitch, (generally called True Pitch) and *Gothick* Pitch.

PEDIMENT Pitch is, when the perpendicular Height is equal to two 9ths of the Breadth of the Building. Common Pitch is making the Length of the Rafters equal to three 4ths of the Breadth of the Building, if it fpan the Building at once; and *Gothick* Pitch is making the Length of the Rafters equal to the whole Breadth of the Building, and therefore is equilateral. Mr. *Smith* recommends the Breadth of the Building within to be divided into 7 parts, of which he gives 2 to the perpendicular Height, and makes the Length of the Rafter equal to 4 of thofe parts, and which is very good for Lead or Pan-tiling, Examples of which he has given in Plates CCCLXXVI. and CCCLXXVII. and whofe Beams he proportions as follows:

If the Bearing of the Beam in the Clear be (Feet)	its Scantling muft be (Inch.)	by	Inches.
12	6	8	
16	6¼	8½	
20	6½	9	
24	7	9[illegible]	
28	7½	9½	
32	8	10	
36	8½	10½	
40	8[illegible]	11	
44	9	12	

PRINCIPAL *Rafters*, at their Feet, fhould be nearly as thick as the breadth of the Beam, and at their top one 5th or one 6th lefs.

KING *Pofts* fhould be as thick as the top of the principal Rafter, otherwife they will not be able to receive it; and their breadth of fufficient Strength to receive the *Struts*, that are defigned to be framed into them, their middle parts being left fomething broader than the Thicknefs.

STRUTS fhould alfo diminifh one 6th, as Rafters. *It is to be noted*, That as the lower parts of principal Rafters are the ftrongeft, the Purlins, Collar-beams, and Struts fhould be placed fomething higher than juft in the middle of

of the Rafter, that the Bearings may be proportional to the Strength, and not in equal parts, as Mr. *Smith* recommends.

PURLINS muſt have the ſame Thickneſs as the principal Rafter hath, in that part which lies on the Purlin, and the Breadth of *Purlins* ſhould be to their Thickneſs, as 3 is to 4; therefore, if the Thickneſs is 6 inch. its Breadth muſt be 8 inch. *Purlins* are generally framed into the principal Rafters, but ſometimes are laid in the Collar-beams. When they are framed into the principal Rafters, their Lengths are equal to the Diſtance of the Principals, excluſive of their Tenons; but when laid in the Collar-beams, they are of twice, thrice, *&c.* that length, as the length of Stuff will admit of.

SMALL *Rafters* may be in their Scantlings 4 inch. by 2 inch. and half, or 4 inch. and half by 3 inch. and half, or 5 inch. by 3 inch. and half, according to the Nature and Strength of the Principals, and whoſe Length, in a purlin'd Roof, ſhould not exceed 7 feet; and when the length of the principal Rafter exceeds 15 feet, 'tis beſt to frame in 2 feet of Purlins, as repreſented by A A, on the upper Side of the lower Figure, in Plate CCCLXXXI. which repreſents the Plan of a Roof: But I cannot recommend the Method of framing the Purlins in a Right-line, becauſe, when the Mortiſes in the principal Rafters are againſt one another, the Rafter is not only weaken'd very greatly in thoſe parts, but you loſe the Pinning alſo, and therefore they ſhould be framed as in Fig. BD, Plate CCCLXXXVI.

THE Proportions of *Pitches*, for the various *Coverings*, as aſſigned by Mr. *Price*, are as follow:

(1) *For Covering with Lead*, Fig. A, Plate CCCLXXXVI. the perpendicular Height is equal to one 4th of the breadth.

(2) *For Covering with Pan-tiles*, Fig. B, Plate CCCLXXXV. the perpendicular Height is three 8ths of the breadth; or as Fig. D, where the Perpendicular is cut by an Arch, whoſe Radius is equal to two 3ds of the breadth.

(3) *For Covering with plain Tiles*, Fig. C, the perpendicular Height is equal to half the breadth; or as Fig. F, whoſe length of Rafter is equal to three 4ths of the breadth, which laſt is called *True Pitch*.

(4) *For Covering with Slates*, Fig. E, divide the breadth into 7 parts, and, with the Radius of 5 parts, interſect the Perpendicular.

THE neceſſary *Scantlings*, aſſigned by Mr. *Price*, for *Beams* and *Rafters*, are as follow:

I. *For Beams or Ties.*

(1) For ſmall Buildings.

	Feet		Inches		Inches
If the Length of a Beam of Fir be	30	its Scantling muſt be	6 by 7	but if of Oak	7 by 8
	45		9 by 8½		10 by 11½
	60		12 by 11		13 by 15

(2) For large Buildings.

	Feet		Inches		Inches
If the Length of a Beam of Fir be	30	its Scatling muſt be	7 by 8	but if of Oak	8 by 9
	45		10 by 11½		11 by 12½
	60		13 by 15		14 by 16

II. *For Principal Rafters.*

(1) For ſmall Buildings.

	Feet		Inches		Inches
If the Rafter be of Fir, and its Length	24	its Scantling at top muſt be	5 by 6	and at bottom	6 by 7
	36		6½ 8		8 10
	48		8 10		10 12
		But if of Oak, at top	7 by 8	and at bottom	8 by 9
			8 9		9 10½
			9 10		10 12

(2) For large Buildings.

	Feet		Inches		Inches
If the Rafter be of Fir, and its Length	24	its Scantling at top muſt be	7 by 8	and at bottom	8 by 9
	36		8 9		9 10½
	48		9 10		10 12
		But if of Oak, at top	8 by 9	and at bottom	9 by 10
			9 10		10 12
			10 12		12 14

III. *For Small Rafters.*

(1) For ſmall Buildings.

	Feet		Inches		Inches
If the Rafter be of Fir, and its Bearing	8	then its Scantling muſt be	3½ by 2¼	but if of Oak	4½ by 3
	10		4½ 2½		5¼ 3
	12		5½ 2½		6½ 3

(2) For large Buildings.

	Feet		Inches		Inches
If the Rafter be of Fir, and its Bearing	8	then its Scantling muſt be	4½ by 3	but if of Oak	5½ by 3
	10		5½ 3		7 3
	12		6½ 3		9 3

Having thus demonſtrated the various Pitches of Roofs, and the ſeveral Scantlings of their parts, the next in Order is their different Kinds of Truſſes.

Plates CCCLXXVI. CCCLXXVII. *Divers Kinds of Truſſes for Roofs.*

The upper two Figures in Plate CCCLXXVI. are Sections of Roofs by *Vitruvius,* which are ſomething higher than *Gothick* Pitch; the other five are of Pediment Pitch, as alſo are the next five, in Plate CCCLXXVII. and therefore muſt be covered either with Lead or Pantiles. The Method of each Truſſing is different, ſome being ſtronger than others, as the Nature of Buildings requires. The lower Figure hath a Valley in it, to take off the *Barn-roof* Aſpect, which it would have, were the principal Rafters continued up to an Angle. In this Roof is Space for two Lodging-rooms, as being framed with a Collar Beam and middle Poſt, which laſt muſt be ſupported by a Wall, or a Partition, otherwiſe the Roof cannot be depended on as very ſecure.

Plates CCCLXXVIII. CCCLXXIX. *Divers Kinds of Truſſes for Roofs.*

The firſt two Figures of Plate CCCLXXVIII. are framed for the Conveniency of making two Lodging-rooms in each, and which are ſomething ſtronger in their framing, than the former, but yet not to be depended on, without the Aſſiſtance of Partitions or Walls under their middle Poſts. The other two Sections

tions in this Plate, and the four others in the next are Designs for Roofs over spacious Rooms of considerable Breadths, as Halls, *&c.* whose Cielings are supposed to be arched, or covered; but I must own, that if some Provision be not made to strengthen or help the first in Plate CCCLXXVIII. as also the third and fourth in Plate CCCLXXIX. at the Meeting of the Collar Beams with the Rafters, I should not be willing to trust any considerable Weight of covering on such Bearings, lest the Principals break at, or just under the Tenons of the Collar Beams. The last Section of Plate CCCLXXVIII. and the two first of Plate CCCLXXIX. are helped very greatly by the lower Struts, as the others must be, to be practised with Safety.

Plate CCCLXXX. *Divers Kinds of Trusses for large Roofs to Churches, &c.*

THE two upper Figures represent two Sections of Roofs fitting for Churches, &c. the first, marked B A B, must be supported within by Columns, which are supposed to divide the Breadth of the Church into three parts, or *Isles*, whose Cielings are circular. As I am now speaking of the supporting of Roofs by inside Columns, as is done in the Church of St. *Martin in the Fields*, I must advertise, that nothing is so monstrous and absurd, as to break the Entablature about such Columns, making them as *Capitals on Capitals*; nay, even to place an Entablature on them, and to continue it is an Absurdity; for, as within Churches no Rains can fall, why must Cornices be introduced there, since that their Business is to carry off the Rains from the Freeze, Architrave, and Column only, excepting when they finish the Height against a flat Cieling, and indeed then they may be considered, as an ornamental Way of finishing, and a Strengthening to the Cieling also. The other Section CDC hath a semicircular Cieling in the Middle, with flat Cielings on the Sides, and where they rest on the Architrave, from whence the semicircular part should have sprung, (and not from the Cornice, which has no Business there) as is judiciously done by Sir *Christopher Wren* within the Church of St. *Andrew, Holbourn*. The principal Posts of this Section have their Support on Columns at E E, as the aforesaid. The two lowermost Sections are after the *Gothick* Manner, and of great Strength; the Principals of the lower one are mortised to receive the King-post into them at its Top, and both have *Demy King-posts* in their Quarter-parts, which, if strapped with Iron, would contribute very greatly to the Strength of the Whole.

Plate CCCLXXXI. *The Plan of a regular Roof, with the Manner of finding the Length of its Hip-rafters.*

THE Use of such a Plan is, to determine the Situation and Number of principal Rafters, small Rafters, and Jack Rafters. The principal Rafters are those 4, that lie thro' the Body of the Plan, with Tenons represented in their Middles; the small Rafters are those between them, marked B; and the Jack Rafters are those shorter ones, whose Tops bear against the Hip-rafters, as those marked C and D. Hip-rafters are those, that stand over the Diagonal Lines, drawn from the Angles, whose Lengths, being longer, than the principal Rafters, are thus found: Suppose, in the upper Figure, that B ϛ represent the Breadth of a Building, and B 3 ϛ a Pair of principal Rafters of common Pitch; continue out the Backs of both Rafters at pleasure, and make 3 F and 3 E each equal to 3 M, the Height of the Pitch, and then, drawing the Lines F ϛ and E B, they will be the Lengths of two Hips, as required; for, as the Lines 3 B and 3 ϛ are the Diagonals, or Bases, over which they must stand, and as the Lines 3 F and 3 E are perpendicular to those Diagonals, and equal to the Height of the Pitch; therefore, if the Lines F ϛ and E B are raised with the Perpendiculars 3 F and 3 E, to stand perpendicularly over the Diagonals 3 ϛ and 3 B, the Points E and F will meet in the perpendicular

cular Point over the Point 3, and consequently, the Lines F 5 and E B will be the central Lines of those Hips. *Q. E. D.*

AGAIN, If on the Points B and 5, with the Length of one of the Hips, you describe the Arches F 2 and E 2, intersecting in 2, and the Lines 2 5, 2 B being drawn, the Triangle B 2 5 will be the hipp'd End of the Roof.

To find the true Angle of the Back of each Hip, draw the Line 5 1 perpendicular to 2 B, which transfer to the Diagonal 3 B, (which is done by taking the Length of the Perpendicular 5 1) and on the Point 5 describe the Arch 1 4; then continuing out the Diagonal 5 3, until it meet the Side of the Building in 13, draw the Lines 4 13 and 4 5, which is the Angle of the Hip required. For if the Triangle 13 4 5 be raised up on the Line 13 5, and if the Hip End 2 B 5 be raised on the Line B 5, so that the Side of the Triangle 4 5 doth lie against the perpendicular Line 1 5, then will the Point 4 lie on the Point 1; and as the Line 4 5 will lie on the Line 1 5, and as the Line 1 5 doth cut the Hip 2 B at Right-angles, therefore the Angle 13 4 5 is the Back of the Hip. *Q. E. D.*

Note, This Rule for backing of Hips is universal, not only for regular Roofs, but for all Kinds of bevel Roofs, as will appear in the following Plates. And if the young Student will but make tryal of two or three different Examples on Paper, or rather on Pasteboard, and cut out the Sides of an Angle, as 13 4 and 4 5, to turn up on the Line 13 5; also make another Piece equal to the hipp'd End, as B 2 5, and apply them together, as aforesaid, he will very plainly understand the Demonstration hereof. The Method proposed by Mr. *Smith* for backing these Hips is as follows: First find their Lengths, as E, B, F, 5, and through the Point 3 draw H G parallel to B 5; also draw the Lines H M and G M, cutting the Diagonals in the Points K and I: *Then saith he*, 'Set the 'Compasses on the Points I and K, and describe the Arch-line on the Hip,' but never says, with what Radius such Arch must be described, and therefore the Learner cannot proceed therein any further; but, however, he has laid down the Angle H 10 M, which he says is the Angle required, altho' far from it; for the Angle 6 4 7 is equal to his Angle H 10 M, which is less, than the true Angle 13 4 5, by the Angle 7 4 8, and therefore is evidently false.

Plate CCCLXXXII. *The Manner of trussing Girders, scarfing Timber, framing Rafters, King-posts, &c.*

THE Trussing of Girders and scarfing of Timber together, according to these Methods, having been already explained in Pl. CCCLXXV. need not be repeated here, and therefore I need only observe some Particulars relating to the Joints of Rafters, King-posts, Struts, Braces, *&c.* (1) At A is *d*, the Joint of the top of a principal Rafter, framed into the top of the King-post *c*, wherein 'tis to be observed, that the Joint be made at Right Angles to the back of the Rafter, because the greatest Thrust is made at a Right Angle. (2) At B is the Joint of a Strut, framed into the bottom of the King-post at *e*; but as this Joint is not so strong as the Joint at *a b*, which is at Right Angles, it is therefore never to be practised but when Timber is scanty, and no very great Strength is required. At D is another Joint, but this, not being at Right Angles to the Joggle, is not so strong as that at C. (3) At E is represented a sure Method to make a proper *Joggle* on a King-post at Right Angles: Let *a b* represent the upper Surface of a Beam, and the Lines *l, i, d, c,* one Side of the bottom of a King-post, the Line *i d* its Joggle, or Joint of the Strut, and the Lines *k i, i d,* and *e d,* the lower part of a Strut, framed into the King-post, first assign the Height of the *Joggle* above the Beam, which let be *c d*; on *d*, with the Radius *d c*, describe the Circle *c i f*; draw *l i* parallel to *d c*, at such Distance as *d c* is allowed to project before it; take the Thickness of the Strut in your Compasses, suppose *d i*, and, setting one Foot on the Center *d*, turn the other to touch the Line *l i* in the Point *i*, and draw the Line *i d*, from whence draw the

the Lines *k i* and *c d,* which is the Strut, and *i d* is the Joint, at Right Angles. (4) On the Right-hand, at I K is ſhewn the Manner of framing the Foot of a principal Rafter, as I, into a Beam, as K, where the Tenon ſhould be at leaſt 4 inch. in Depth, its Bottom parallel with the Surface of the Beam, and its Noſe or End at Right Angles to its Bottom, that thereby it may have a direct Thruſt, or Butment againſt the Upright of the Mortiſe. (5) The Figures G F and H I repreſent the Proportions of Tenons and Mortiſes for theſe and other Works, as Partitions, &c.

Plate CCCLXXXIII. *Various Methods for framing Partitions, and to delineate the Out-lines of Regular and Irregular-hipp'd Roofs in Ledgment.*

THE ſeveral Methods of framing Partitions, according to theſe ſeveral Examples, being already explained in Plate CCCLXXIII. need not be repeated here; therefore I ſhall proceed to the delineating of the Roofs.

I. *Of the Regular Roof,* Fig. M.

(1) LET the Parallelogram *c b d* 4 be a given Plan, through which draw the central Line *f e* extended both Ways; make *b h,* 4 *g, c i,* and *d k* each equal to (*b e*) half the Breadth of the Building, and draw the Lines *h g* and *i k* extended both Ways, alſo draw the Diagonal Lines *t b* and *t* 4; make the Baſe of the *Iſoceles* Triangle on the Left equal to the breadth of the Building, and make its Perpendicular equal to the given Pitch, then will the equal Sides of that Triangle repreſent a pair of principal Rafters; and if the greater Segment of the Baſe be made equal to *t b,* the Baſe of one of the Hip-rafters, and the longeſt Side be drawn to it, it will be the Length of each Hip. (2) Make the Sides of the Triangles *b* 6 4 and *n c d,* each equal to the Length of the Hip; alſo make *i o, h p, k m,* and *g* 2, each equal to the Length of a principal Rafter, which is, to one Side of the *Iſoceles Triangle,* and then, drawing the Lines *c o, o p, p b* on the upper Side, and *d m, m* 2, 2 4 on the lower Side, they will be the four Sides of the hipp'd Roof, as required. And as ocular Demonſtration is the eaſieſt to many, therefore, after having delineated the Figure, cut out the Out-lines, and bending the Skirts up on the Lines of the Plan *c b, b* 4, 4 *d,* and *d c,* the Points *m, n, o* will meet together in one Point, as alſo will the Points *p,* 6, 2, and the Lines *m* 2 and *o p* will be but one Line, as likewiſe will *p b* and *b* 6, alſo 4 6 and 4 2, alſo *m d* and *d n,* and, *laſtly, n c* and *c o,* and the whole a perfect Model of the Roof required.

II. *Of the Irregular Roof,* Fig. O, *whoſe Sides are parallel, and Ends oblique.*

(1) LET the Trapezium *c u d b* repreſent an irregular, or bevel Roof; divide each Angle into two equal parts by the Lines *e u, e b, c c, c d,* which Lines repreſent the Baſes of the four Hips; through the Points *c* and *e* draw the Lines *g h* and *i k* extended both ways, at Right Angles to the Sides; make *g h,* in Fig. P, equal to the breadth of the Building, and making *e r* equal to the given Pitch, then *g r, r h* is the Length of the principal Rafters; make *e d,* in Fig. P, equal to the Baſe of the Hip *c d,* and draw *r d,* in Fig. P, for the Length of that Hip; alſo make *e c,* in Fig. P, equal to the Baſe of the Hip *c c,* and draw *r c* for the Length of that Hip; alſo make *e b,* in Fig. P, equal to the Baſe of the Hip *e b,* in Fig. O, and draw the Line *r b* for the Length of that Hip; *laſtly,* make *e a,* in Fig. P, equal to the Baſe of the Hip *e u,* and draw the Line *r a* for the Length of that Hip. The Lengths of the ſeveral Hips being thus found, make *p o* equal to *r d* in Fig. P, alſo *c o,* to *r c*; in like manner make *b l,* in Fig. O, equal to *r b* in Fig. P, alſo *u l* equal to *r a*; make *m h, k n, i p, q g,* each equal to *g r* in Fig. P, and draw the Lines *p q* and *n m*; alſo make *c p* equal to *c o, u q* to *u l, b m* to *b l,* and *d n* to *d o*; then will *c p q u* and *d n m b* be the Sides, and *u l b* and *o c d* the Hip-ends required, and which, being cut out, and folded

folded up, as before in the other Example, will be a Model of the Roof, as required.

To back these Hips after Mr. POPE's Method.

IN Fig. M bisect the Base of the Hip *t* 4 in *r*, make *s t* equal to the Height of the Pitch, and draw *s* 4 for the Hip; on *r* take the nearest Distance to the Hip, and turn it to *u*; then, drawing the Lines *u e* and *u g*, the Angle *g u e* is the Angle, or Back of the Hip required. This Method, tho' believed by many to be false, is very true in all square Roofs, but in bevel Roofs 'tis very false, as may be seen in Fig. O, where the Angle at *x* is the true Angle found by my *General Rule*, and that at *m* is by this Method, and whose Lines, were they true, would be parallel to the Lines of the other, but instead thereof, in all Obtuse Angles, the Angle of the Back is too wide, and in all Acute Angles, as *b*, too narrow, and which is evident from the Lines of this Plan.

Plate CCCLXXXIV. *Demonstrating some necessary Observations relating to the Situation of Timbers, in framing the general Plan of a Building.*

ADMIT MNOLKI be a given Plan, divided on its Sides into its Windows and Doors, with the several Stacks of Chimneys in the Walls, which are represented by the little Squares: It's here to be observed, (1) That the Girders or Beams be laid on the Piers, to have solid Bearings, and those in the Walls not too near the Funnels. (2) That no Joists be laid into the Chimneys, wherefore there must be *Trimming Joists* framed without them, as in the Plan. (3) That the several Beams be so connected together, that they may strongly resist the Thrust and Weight of the Roof. (4) To discharge the Weight of the Roof from any particular part, as from over the Lobby F, place Partitions over it, trussed up, as at P, which will discharge the Weight, and lay it on the Party-walls.

THE Roof of such a Building may be framed three different Ways; as, (1) By the Span being divided into three equal parts, as X, R, S, having two Gutters within, and one all about, with a Parapet-wall to cover the Whole. (2) By one pair of Rafters spanning the Whole, hipp'd in Front and Rear, as represented by the right-hand Side; and, *lastly*, with a Flat on the top, as at W, with a Balustrade on it, and which is oftentimes necessary, when the Hall or Lobby, as F, cannot receive any Light, but such as may be given at its top. The Figure Y is a Truss fitting to be used to X R S, and that of Z to that of T; which last will lay a part of the Weight of the Roof on the Party-walls, and which is an excellent Method, for thereby the Out-walls are relieved, and need not be of such great Thicknesses, as they otherwise should, when the whole Weight of the Roof is laid on them.

THE other Plan *d c b a e* is a Plan of an irregular, or bevel Building, which is given to shew *How to back its several Hip-rafters*, as follows; (1) Assign a Point, as *f*, for the Center, or Point of meeting of the Base of every Hip, to which draw Right Lines from the several Angles. (2) Assign the Height of the Pitch, as *g f*, and draw *g f* at Right Angles to *c f*, then drawing *c g*, it will be the length of the Hip, that is to stand over the Base *c f*. (3) In the same Manner draw Lines from the Point *f*, at Right Angles to the several Bases, and making each equal to the Height of the Pitch, draw their several Hips; so *f g*, being at Right Angles to *f a*, and equal to *g f*, then *g a* is the length of the Hip, that is to stand over the Base *f a*, and so the like of all the others.

To find the Backs of (these) *bevel Hips.*

DRAW a Right Line at Right Angles to the Base of the Hip, through any part of it, as the Line *l m*; then setting one Foot of your Compasses on the Point of Intersection, take the nearest Distance to the Hip *g a*, and turn that Foot on the Base, as to *n*, from whence draw Right Lines to the Points *l*, *m*, where the Line cuts the Out-lines of the Angle of the Plan, and the Angle

l n m

l n m will be the Angle of the Back of the Hip *g a* required. In the like Manner the Angle *h c i* is the Back of the Hip *g c*; and ſo of all others. The Figures S, R, T, relate to finding the Angles of Purlins againſt Hip-rafters, an Account of which you'll find in the *Index*, under the Word *Purlin*.

Plate CCCLXXXV. *Divers Truſſes for Roofs.*

HERE are eight Examples of Roofs, of which thoſe marked I, E, G, H, D are framed open, ſo as to contain Garrets within them; the others are for larger Buildings, where ſuch Room is not required.

Plate CCCLXXXVI. *The principal, and Hip-rafters of a regular, and an irregular, or bevel Building exhibited.*

THE upper Plan Q is a Parallelogram, wherein are repreſented its *Plates*, Beams, and Mortiſes, to receive the principal and Hip-rafters. The Figure S ſhews one of its Hip-rafters, as when ſtanding in its place, and by which you ſee the Quantity of its Angles at the Head and Foot. Fig. R repreſents one pair of the principal Rafters fixed upon its Beam, with its King-poſt and Struts. Figures W, T, repreſent the Hip-rafters of one End, together with one principal Rafter, and the Purlins framed into it, between them. Fig. V repreſents the Principals contained in one Side, with their Purlins framed into the Hips, and wherein the Purlin Joint is repreſented. The irregular Plan A is a Trapezia, wherein 'tis ſuppoſed, that the Beams are required to lie bevel to the Sides. The dotted Lines, drawn from the Plan A to the Skirt B, how much each principal Rafter muſt lie bevel; and which is juſt as much as half the Beam doth, that the Rafter is to ſtand on. The Side of each principal Rafter, and the pricked Line is the true bevel of each, as is evident by the Skirts, repreſented here in Ledgment, being conſidered with the Obliquity, or bevel of the Plan. The Truſs A is the moſt plain and ſimple of all contained herein, and the beſt for all kinds of Roofs, that are not of very great Extent.

Plates CCCLXXXVII. CCCLXXXVIII. *Various Truſſes for Roofs of a large Extent.*

IN the firſt of theſe Plates are nine different Truſſes, of which thoſe marked *s*, *q*, *r*, are fit for Churches, *&c.* of which that marked *q* ſpans beyond the Walls, as that of St. *Paul*, *Covent-garden*, where they are ſupported by Columns within, which is a great Help to the Walls, and is a very firm Way. The Truſſes *p*, *o*, are for thoſe Kinds of Roofs, that are called M-roofs, having Gutters on the King-poſts in their Middle, and which are often uſed to abate the Height; that of *o* is two thirds, and that of *p* is three quarters of the Height. The others, marked *n*, L, *m*, K, are for Rooms with arched Cielings, and of very ſtrong Compoſition. The Piece marked *b b* is called a *Collar-beam*, and theſe marked *d d* are called *Hammer-beams*.

IN Plate CCCLXXXVIII. are eight Deſigns for Truſſes of great Span; that marked A is fit for a Building, from whoſe top fine Views may be ſeen; that of B is called a *Cirb-roof*, and much eſteemed on account of its giving much Space within-ſide. The Truſſes Y X, W V, and Z, and G Z are different in their Sides; thoſe of the left, being as ſome particular Roofs, in or near *London*, are framed, and not being of the very beſt Compoſition, the right-hand Sides are to ſhew, how they might have been framed with a great deal leſs Timber, and a great deal more Strength. As 'tis oftentimes neceſſary to fortify the Meeting of Timbers with Iron Straps and Bolts, 'tis good to obſerve (as in Fig. D) to turn up the End of the Straps ſquare, and to bolt on the Straps with ſquare Bolts, which cannot turn within the Holes at the time of ſcrewing

ſcrewing on the Nuts, which round Bolts will do, and therefore cannot be ſcrew'd ſo faſt as they ought to be.

Plate CCCLXXXIX. *The Proportion and Manner of framing Spires on Steeples or Towers.*

THE three Spires A, B, C, have their Heights proportioned as follows. (1) Make a regular Octagon, as *c e g d*, Fig. D, whoſe oppoſite Sides are equidiſtant, equally to the Sides of the Tower, on which the Spire is to ſtand. (2) Make the Height of the Spire A, equal to 8 times the Side of the Octagon, the Spire B to nine, and the Spire C to ten. Make the Height of A equal to four of its own Diameters, that of B to 4 Diameters and 1 half, and that of C to 5 Diameters.

To find the Height of Weather-Cocks with their Ornaments.

MAKE a regular Octagon, as *c e g d*, Fig. D, whoſe oppoſite Sides are equidiſtant, equally to the Sides of the Tower, on which the Spire is to ſtand. Set up 8 times the Side of the Octagon for the Height that the Hip-rafters are to riſe in Fig. A, 9 times in B, and 10 times in C; and the Remainder of the Height is the Height of the Vane, whoſe Length is equal to two 3ds of one Side of the Octagon, divided into three parts, *viz.* one for the Pointer, and two for its Plate.

ALTHO' Towers are generally built ſquare, yet Spires are commonly made octangular at their Baſe; as is that ſurprizing Spire at *Salisbury*, which ſtands on a Tower of 200 Feet high, and its ſelf riſes near 210 Feet more. The Manner of forming their octangular Baſes is repreſented in Fig. D, wherein *c a e f g h d b* is the Baſe of the Spire, which is tyed in a very ſtrong Manner, by the interſecting Squares that are halved together and framed into it, and by the ſhort angular Beams *n, o, x, q, r, z, s, t,* being cogg'd down, on which the Hips ſtand, and framed into. A Frame being thus prepared, and bolted down upon the Heads of eight Standard Oaken Poſts, worked up in the Body of the Walls of the Tower, wherein, at proper Diſtances, croſs Pieces are let in, and worked up within the Walls, will ſtand to the End of Time, could the Materials ſo long endure; for by its being ſo tyed down by the Weight of the Tower, if 'tis made with good ſeaſon'd Timber, and well framed together, it can never rack, ſhake, heave, or fall down, except the Tower and that are overſet together. As each Side of ſuch Spires are reclining and contracted at their Tops, they do therefore truſs up each other, as in the Figures is demonſtrated.

AS there is more Difficulty to frame a Spire with a Lanthorn under it, as the Spire G, this Maſter has given us Fig. I. which repreſents the Manner of the Timber framing, embracing the Top of the Tower at *c d*; alſo the Manner of framing the Lanthern, as Fig. L, and the Cirb to its Head at *e f*, as Fig. K, which two laſt Figures are repreſented more at large, than the others are, for the better underſtanding of them. The Plan H, repreſents a proper Frame to be placed at *b a*, under the Spire F, whoſe Timbers are very well connected together. As to the Deſigns of both the Towers, placed under theſe two laſt Spires, I muſt own, would have been better, had this Maſter omitted them, they being a manifeſt Proof of a Barrenneſs of Invention.

Plate CCCXC. *The Manner of framing curved Roofs to* cylindrical Buildings.

THE great Difficulty in theſe Kinds of Roofs is the Plan, which muſt be ſo contrived, that the Preſſure of the Truſſes may not thruſt out the Plates. The beſt Way to effect this, is to frame and cogg down an octagon Plate on the

the circular Plate, ſo that the Middle of its inward Side be fluſh with the Upright of the Wall within, and its Angles being braced, with Tyes cogg'd down, it will be very ſecure againſt all the Thruſt that can be made by any Roof. The upper Truſs L is a *Caveto*, the next two, K I, are *Cima recta*'s inverted, and the lower one an *Ovolo*, which laſt is very ſtrong, and of my own compoſing.

Plate CCCXCI. *The Manner of framing* Hemiſperical Roofs, *commonly called* Domes.

This Plate exhibits the Plans and Sections of three Kinds of Domes, which I ſhall deſcribe as follows.

Firſt, the Semiplan B, by which the whole Plan or Circle is to be underſtood, (whoſe Section is Fig. A.) the outer Circle of the Plan marked *b b*, repreſents the Plate, the ſmall Circle *c c* the Kerb, on which ſtands a Lanthorn (as in the Section,) the Lines *a a* the Baſes of the principal Rafters or Ribs, and *g*, *h*, *i*, the Purlins. This Dome being half a Sphere, its principal Rafters would be all Quadrants, were they not ſhortened by the Lanthorn on its Vertex; and as their Height is equal to the Semidiameter of the Plate, they have therefore the ſame Curvature, and are cut by the ſame Radius, or Mould. As the Plate and principal Rafter cannot be made too ſecure, 'tis therefore beſt to make them in two Thickneſſes, well-pinn'd (and bolted, if in large Roofs) together, and, if poſſible, to cut them out of *Engliſh* Oak, whoſe natural Curve is nearly the ſame with that of the Plate, *&c.* The Diſtances of the Purlins *e*, *d*, in the Section, are equal, each being at one 3d of the Rafters length; and if from *e d* Perpendiculars be let fall on the Diameter of the Plan, as *f* and *g*, to paſs thro' thoſe Points, where the Perpendiculars cut the Diameter, they will be the Moulds, by which both the Purlins are to be cut out, in order to be worked up (not ſquared, as Mr. *Price* calls it) for Uſe: In doing which, Care muſt be taken to make their Backs agreeable to the Curvature of the Principals, and that their upper and under Surfaces have a true Somering to the Center, that thereby the Angles of the ſmall Rafters on the under and upper Side of the Purlins may be equal, and at Right-angles to them, as being the ſtrongeſt, and beſt Manner of framing.

To find the Somering and Curvatures in the Section of the Purlins.

Set up on the Back of a principal Rafter, from its Foot, the Height of the Purlin from the Plate, and the Height of the Purlin alſo; from which draw Right-lines towards the Center of the Principal, until they meet its under Side; then thoſe Right-lines, taken with the outward and inward Curves of the principal Rafter, will be a Section of the Purlin, from whence the ſeveral Bevels, or Angles being taken, and transferred upon the rough Purlins, and the Surplus cut away, the Remainder will be the Purlins, with their true Curvatures and Somerings, as required.

N. B. It is abſolutely neceſſary, that the Curvature and Section of theſe Purlins be well underſtood, before the Sawyers go to work, and wherein there is no Difficulty; for if Care be taken herein, the Work and Time required to finiſh them will not be very conſiderable.

The middle Figures F, K, repreſent the Plan and Section of the Domes in the Cathedral of St. *Paul, London*; the interior Dome, whoſe Painting is a Monument to the Memory of Sir *James Thornhill*, deceaſed, is expreſſed by the Segments of Circles on each Side *e e*, which is of Bricks, made 2 feet in length for that Purpoſe. The middle part *e e* repreſents a circular Newel, or Opening in the Vertex of the Dome, thro' which from below you ſee up to the Windows *b b b*, &c. which give Light from the upper part of the external Dome. From the Baſe of the internal Dome aforeſaid riſes the Fruſtum of a Cone, made of Bricks 18 inch. in Thickneſs, whoſe Uſe is to carry the Cupola

 ſtanding

ſtanding on the external Dome, at G. This Fruſtum (which Mr. *Price* miſtakenly calls a *Cone*) having a very conſiderable Thruſt againſt the Walls that carry it, I ſuppoſe, were one Motive of inducing Sir *Chriſtopher* to ſtrengthen that part with a Corridore on the Outſide, which is very grand, and beautiful alſo; and, indeed, if we conſider, that the Cupola ſtanding at G on the ſaid Fruſtum is built with *Portland* Stone, and near 60 feet high, it is a very great and maſterly Performance, and an undeniable Proof of its Architect's moſt exquiſite Judgment, and extenſive Knowledge in GEOMETRY. The external Dome H is ſpheroidical, and hath ſome Dependence on the Fruſtum aforeſaid, its horizontal, or Hammer-beams *e e*, &c. having their Ends dependent on the Stones *c c*, &c. where they are curiouſly tied together with Iron Cramps, that are run with Lead into the Stones, and then bolted through the Hammer-beams.

AS the Manner of framing the Timbers of this Truſs is made plain by the Section, nothing more need be added, but that the Number of thoſe ſingle-truſs'd principal Ribs is thirty-two, as in the Plan I is demonſtrated, where they are obſtructed at *a a*, &c. to admit Light to the Windows *b b*, &c. as aforeſaid. It is to be obſerved, that in this great Dome there are not any Purlins, but it has horizontal Ribs inſtead, by means of which the Covering-boards, that are nailed thereon, have very little Curvature. Within this Framing is a Stair-caſe, not here repreſented, which leads to the Balcony *d d*, from whence extenſive Views may be ſeen, when the Air is ſerene and clear.

THE Figures C and D repreſent the Plan and Section of a third Dome, which is alſo ſpheroidical, and hath an internal, ſpherical Dome, as that of St. *Paul*'s. This Dome is made to fit a Temple of about 80 feet Diameter, and the Walls to an 8th part of the Opening; but the Lanthorn, placed on its Vertex, muſt not be made of *Portland* Stone, as that at St. *Paul*'s, becauſe here is no Proviſion made to carry ſuch a Weight.

THE Manner of framing the Kerb to the Opening of the Lanthorn at C, as repreſented by the interſecting Timber-ſquares halved together, as at D, is very ſtrong, and ties that part of the Roof well together, but there is not any Proviſion made to prevent the Weight of the Cupola from thruſting out the Hanches of both Domes, excepting the lower Brace on each Side, wherefore I can't but recommend the placing of Struts from the Baſe of the outer Dome up unto the Bottoms of the two upper King-poſts, which, together with the Struts, that go from the Bottoms of thoſe King-poſts up to the Side of the Opening, will be capable of ſupporting a Lanthorn of a very great Weight, which, without them, would never ſtand. Thus much by Leave of this Maſter, whoſe Works, as well as thoſe of Mr. *Smith*, I have (if I miſtake not) explained to the Underſtanding of young Students ſomething more largely, and plainer, than they themſelves (or their Scribes) have done, and that, I hope, without Offence, as being done for the publick Improvement of the noble Art we are now treating of.

Note, This Dome is made to conſiſt of ſixteen principal Rafters, or Ribs, which is a mean Proportion between the former two, the one of eight, the other of thirty-two, and which may be framed with Purlins, as the firſt, or with horizontal Ribs, as that of St. *Paul*'s.

Note alſo, That if to a Dome there are but 12 principal Rafters required, then, inſtead of making the Kerb of its Opening with two geometrical Squares, as at D, you muſt apply two equilateral Triangles together in the ſame Manner, which will produce ſix external, and as many internal Angles, in the ſame Manner as the interſecting Squares produce eight internal, and as many external Angles, for the Reception of the ſixteen Ribs.

HAVING thus explained the Formation of circular Roofs, I ſhall only add, that the Feet of all principal Rafters to Domes ſhould extend no farther, than the Upright of the Wall, but thoſe to Roofs, where their Forms are *Cavetto's*, or *Cima's*, as Figures L, K, I, Plate CCCXC. may extend to the Extremity of the Cornice

Plate

Plate CCCXCII. *Triangular, ſquare, and oblong Roofs demonſtrated.*

THE Plan *c b a*, Fig. I, is an equilateral Triangle, whoſe Height of Pitch is *k d*. *To form this Roof*, divide each Angle into two equal parts by the Lines *c d s*, *b d*, and *a d*, which are the Baſes, over which the Hips muſt ſtand; on the Line *c s*, at the Point *d*, erect the Perpendicular *d k*, which make equal to the given Height of the Pitch, and draw *k c* for the length of one Hip, and *k e* for the length of one principal Rafter. The length of the Hip *k c* being thus found, complete the Triangles *c f b*, *b r a*, and *c p a*, making each of their Sides, as *c f*, *f b*, &c. equal to the length of the Hip *k c*, and then will the Extreams of the three Sides of the Roof be laid out in Ledgment.

To back the Hips.

CONTINUE the Sides *c f* and *c p* out at pleaſure, and from the Points *b* and *a* let fall the Perpendiculars *b g* and *a q*; make *a d* equal to one of thoſe Perpendiculars, as *a q*, and draw the Lines *b d* and *d a*, then is the Angle *b d a* the back of the Hip required.

THE Plan *c a p o*, Fig. II. is a geometrical Square, and the Plan *b a 2 z*, Fig. III. is a Parallelogram, whoſe requiſites are found, according to any given Pitch, in the ſame Manner, which their Lines do very plainly demonſtrate.

Plate CCCXCIII. *Oblique-angled (commonly called bevel) Roofs demonſtrated.*

THE Plan *a c b d*, Fig. I. is a Rhomboides, in which its principal Rafters are placed at Right-angles to its Sides, and the Plan *b o d i*, Fig. II. is the ſame Figure, with its principal Rafters placed parallel to its Ends. The Plan *c d a b*, Fig. III. is a Rhombus, whoſe Hips are *c i* and *d g*, &c. and Principals *n f* and *o h*, &c. the length of which, as alſo of the other two Examples, being found by the aforeſaid *Rule*, and which their Lines very plainly demonſtrate, need no farther Explanation.

Plate CCCXCIV. *An irregular Roof demonſtrated, with a* GENERAL RULE *for backing of principal Rafters.*

THE Plan *c b d a*, Fig. I. is a Trapezium, whoſe Sides in general are unequal, and conſequently all the Angles are the ſame. To frame this Roof, ſo as to make the Ridge level, is a Work of ſome Difficulty, and the Method of performing it is as follows. Suppoſe the Side *a b* to be the Front, to which the Ridge muſt be level; divide the Angles *d a b* and *c b a* each into two equal parts, by the Lines 11 *a* and *g b*, and let the Line 11 *g* be the Baſe of the Ridge; alſo let 11 14 be the given Height of the Pitch; from the Point 11 draw the Line 11 12 at Right-angles to 11 *a*, and 11 13 at Right-angles to 11 *d*; make 11 12 and 11 13 each equal to 11 14 the Height of the Pitch, and draw the Lines 12 *a* and 13 *d* for the length of thoſe Hip-rafters: In the ſame Manner, on *g*, draw *g h* at Right-angles to *g b*, and *g i* at Right-angles to *g c*, each of which make equal to the Height of the Pitch, and draw *c i* and *h b* for the lengths of theſe two Hips. This done, aſſign the Places for the Beams, and where the Beams cut the Line *g* 11, there raiſe Perpendiculars to them equal to the Height of the Pitch, and from thence draw Right-lines to the End of each reſpective Beam, and they will be the lengths of the ſeveral principal Rafters; in the ſame Manner the lengths of every pair of ſmall Rafters are to be found; the backs of each Hip are found by my *Rule* before given, which the Lines within the Angles at *c* and *d* demonſtrate. The Triangles *d* 1 *a* and *c e b* are the Hip-ends, and the Trapeziums *u c* 10 *d* and *b x a z* are the two Sides of the Roof

Roof laid out, and which, being turned up to meet each other, will ſhew the whole Figure of the Roof: As the Side *c d* doth not cut the Feet of the Rafters at Right-angles, they muſt therefore be all backed, which may be done as follows:

To find the Backs of Rafters in a bevel Roof.

LET the parallel Lines *t* repreſent the Plate, the Line *r* the Baſe of the Ridge, and the Lines *k x* and *i w* the Baſe of a Rafter, over which 'tis to ſtand when up in its place, and let *k i* repreſent the breadth of the Foot of the Rafter: From the Points *o* and *n* draw the Lines *o q* and *n m*, at Right-angles to the Lines *k o* and *i n*, and make each equal to the Height of the Pitch, and draw the Lines *q k* and *m i*, which are the lengths of each Side of the Rafter, alſo draw the Lines *a l* and *p f* for the Depth of the Rafter; from *a* draw *a c* at Right-angles to *i m*, alſo from *f* draw *f h* at Right-angles to *k q*; from *c* draw *c b* at Right-angles to *i w*, and from *h* draw *h g* at Right-angles to *k x*; from *g* draw *g e*, and from *b* draw *b d*, at Right-angles to the Plate; on *a*, with the Radius *a c*, cut the Line *b d* in *d*; and on *f*, with the Radius *f h*, cut the Line *g e* in *e*; then drawing the Lines *e f*, *e d*, and *d a*, the Trapezium *e d f a*, will be a Section of the Rafter cut through at Right-angles, and then its ſeveral Angles are the Angles of the Back required. For if the Sides of the Rafter *q p k f*, and *l m i a*, were turn'd up to ſtand over the Lines *k o* and *i n*, then the Points *q* and *m* would be perpendicular over the Points *o* and *n*; and if the Trapezium *e d f a* was turn'd up on the Line *f a*, to meet the Sides of the Rafter, the Point *d* would be at the Point *c*, and the Point *e* at the Point *h*; and as the Lines *f h* and *a c*, are at Right-angles to the Sides of the Rafter, therefore the Trapezium *e d f a* will cut the Rafter at Right-angles, and be the Section required. *Q. E. D.*

Plate CCCXCV. *Other oblique (or bevel) Roofs demonſtrated.*

THE two Plans repreſented here are both the ſame, but their Manner of Framing are different. That of Fig. I. hath a level Ridge all round it, with a Flat or Valley *f e h g* in the midſt, and which, in ſuch Caſes, is the beſt and handſomeſt Manner of Working. That of Fig. II. hath its Ridge level; and as every Pair of its Rafters are of different Lengths, the Sides of the Roof will be curved, or rather twiſted, not flat as in other Roofs, and which has not only a very ill Effect, but is very troubleſome in the working. The Manner of finding the Lengths and Backs of every Rafter is the ſame, as aforeſaid, and which the Lines demonſtrate; or as Mr. *Price* commonly ſays, (in his *Treatiſe of Carpentry*) *due Inſpection* will make plain.

Plate CCCXCVI. *The Reaſons and Manner of Backing Circular and Convex Hip-rafters.*

ADMIT BDF to be the Angle of a Building, over which is to ſtand the convex Hip-rafter NL 10, whoſe principal Rafters are *Quadrants* or *Ovolo's*, as the Arch *i a*, which is ſuppoſed to ſtand over the Line *i* E.

To find the Curve of the Hip-rafter.

LET FE repreſent the Baſe of the Hip, and *i* E the Baſe of the Principal, as aforeſaid. Divide *i* E into any Number of equal parts, ſuppoſe four, as at *h g f*, from whence draw the Ordnates *h d*, *g c*, and *f b*; divide FE into the ſame Number of equal parts, as at 25, 24, 23, and draw the Ordnates 25, 28, 24, 27, 23, 26, and E 10, equal reſpectively to the Ordnates *h d*, *g c*, *f b*, and E *a*; and through the Points 10, 26, 27, 28, M, trace the elliptical Curve, which is the Curve of the Hip required, whoſe Depth or Thickneſs is ſuppoſed to be LN.

To

To find the Back of an elliptical Hip.

STRIKE a Chalk-line down the middle of the Back of the Hip, and to its Foot fix a Mould of the Angle equal to that of the Plan, ſo that the middle Line ſtand exactly at the Angle, as at F; and if we ſuppoſe the Breadth of the Back to be equal to ON, then the Parallellogram ONML will be the Plan of the Foot of the Hip, which projects beyond the two Sides of the Angle, equal to the Triangles FM*, and FL*; this done, draw Right-lines on each Side of the Hip-rafter, at any Diſtance from each other, parallel to its Baſe; and on each, from the outward Angles of the Hip, ſet off the Diſtance L*, as P*, Q*, *&c.* in which Points, fix ſmall Nails, and with a thin Lath apply'd to every of them trace a Curve on each Side. Laſtly, cut away all the Timber contain'd between theſe Curves and the central Chalk-line, and the Angle made thereby, will be the Back of the Hip required.

DEMONSTRATION.

DRAW E *e* at Right-angles to F *e*, and continue it to the other Side at B; divide BE and E *e* into 4 equal parts (as F) at the Points *m*, 15, 14, 13, 12, 11, and from thence draw the Ordnates *m* 22, 15 21, 14 20, EG, 13 18, 12 17, 11 16, which make equal to the Ordnates of the Principal or Hip, that is, make 14 20, and 13 18, each equal to 23 26; alſo the Ordnates 15 21, and 12 17, each equal to the Ordnate 24 27; and laſtly, the Ordnates *m* 22, and 11 16, each equal to 25 28, and from the Point *e*, through the Points 16, 17, 18, 19, 20, 21, 22, to B, trace the Semiellipſis B 19 *e*: Now, foraſmuch as the Ordnates of the Hip are reſpectively equal to the Ordnates of the Semiellipſis, therefore, if the Ordnates of the Hip be erected perpendicular on its Baſe, and thoſe of the Semiellipſis on its Diameter BE *e*, their reſpective Heights will be equal; and the Semiellipſis B 19 *e* will be the Section of the Roof, cut through at Right-angles to FE, and conſequently that part of its Curve ſtanding over E, is that part of the Hip's Back: To find the Angles of the Back ſtanding over any given Place, ſuppoſe over the Point 24, draw the Line 24 *e*, or 24 B, and at the End 24, erect the Perpendicular 24 30, equal to the Height of the Pitch, and draw the Line B 30, which transfer to I, and draw BI, which divide into 4 equal parts, from whence draw Ordnates of Length at pleaſure. Now, foraſmuch as the Ordnate *c g*, of the Principal *i m a*, is the Height of the given Point in the Hip, which is alſo equal to the Ordnate 24 27; therefore draw the Line *c i*, which divide into the ſame Number of parts as BI, and from thence draw Ordnates to the Arch *i c*; make the Ordnates of BI equal to thoſe of the Arch *i c*, and thro' their Extreams trace the Curve B *a* I, which is 1 half of the Angle of the Back, ſtanding over the given Point 24; make the Curve I *e* equal to the Curve BI, and the Angle BI *e* is the Angle required. In the ſame Manner the curved Angle at any other Point may be found, as by the Lines is demonſtrated.

To find the Hip-rafter, where the principal Rafter is a Cavetto, as Fig. I *and the Angle of its Back.*

ADMIT C *g a* to be the Angle of a Building, and the Curve 8 6 *y* a principal Rafter, ſtanding over the Line *t y*, and 'tis required to find the Curvature of the Hip *d g*; draw the Line *t g* for the Baſe of the Hip, which divide into the ſame Number of equal parts, as you do the Baſe of the Principal *t y*; ſuppoſe 4, as at *s p o*; from whence draw Ordnates, equal to thoſe drawn in the Baſe of the Principal, and making *s h* equal to 7 *u*, *p k* equal to *w*, and *m* equal to *x*; from the Point *d*, through the Points *h*, *k*, *m*, to *g*, trace the Curve *d h k m g*, which is the Curvature of the Hip required.

Note, The Method by which the foregoing Hip was back'd, will alſo back this, or indeed, any other Kind whatſoever, as Cima's, *&c.*

To describe the Angle made on the Back in any assigned part of it, suppose at the Point of h.

MAKE *g e* at Right-angles to *g t*; and from *e*, through the Point *h*, draw the Line *e h i*, meeting *g t* continued in *i*. Through the Point *i* draw the Line 15 *i a*, cutting each Side of the Angle in 15 *a*; make *i b* equal to *i h*, and draw the Right-lines *b* 15, *b a*. Now, forasmuch as the Ordnate 7 *u* is equal to the Ordnate *s h*, they are, when in their Places of equal Altitude; and as *h* is the given Point, and the Point is equal to it, therefore draw the Line 7 *y*, which divide into Ordnates, as 1, 2, 3, 4, 5, 6; divide *b* 15 into the same Number of equal parts, as 7 *y*, and make its Ordnates equal; thro' whose Extreams trace the Curve 15 13 11 10 *b*; make the Curve *b* 16 *a* equal to the aforesaid, and the curved Angle 15 *b a* is the Angle of the Back of the Hip, over the Point *h*, as required. In like Manner, the curved Angle *z r f* is the Back over the Point *k*, and that at *l* over the Point *m*. It is to be observed, that the Angle of the Back of this Hip increases from its Foot, even from a real Point, and opens as it ascends to the Top, where it becomes an Angle, equal to that of the Building over which it stands; and on the contrary, the Angle of the Back in the aforesaid Hip, where the principal Rafter is an Ovolo, there the Angle at the Foot of the Hip is equal to the Angle of the Building, and decreases as it ascends, unto a very Point at the Top.

THUS much for Roofing, which, being understood, will enable any Person to easily perform all Works of this Kind, that may happen to be done, and which I have been the more copious in, as being one of the most eminent parts of a Building, and never before made plain to mean Capacities, which here I have endeavoured to do.

Plates CCCXCVII. CCCXCVIII. *Coverings for curved Roofs.*

IN Plate CCCXCVII. are represented six Figures, that of Fig. I. being a spherical, and Fig. II. a spheroidical Dome, whose Manner of Covering has been already explained in my Explanation of Niches: *Vide* the Word *Niche* in the *Index*. The Plans, Fig. III. IV. V. VI. are all Hexagons, but the principal Rafters of each are different, that of Fig. III. being a *Cima recta*, Fig. V. a *Cima reversa*, Fig. IV. an Ovolo inverted, and Fig. VI. a Cavetto inverted.

To find the Curvature of their Hip-rafters.

RULE. Divide the Base of the Principal, and of the Hip, each into any Number of equal parts, as *a* 9 and 9 1, Fig. III. and draw equal Ordnates in each, which will give the Points *p, q, r, s, t, u, w, e*, through which a Curve being traced, is the Curvature of the Hip required. In the same Manner all the other Hips to the other Figures are found, as the Lines of each demonstrate.

Their Manner of Covering.

CONTINUE out the Base of a principal Rafter, as 9 1, to 18, making its length 1 18 equal to the length of the Curvature of the principal Rafter 1 17; divide the Base of the Principal 9 1 into any Number of equal parts, as at the Points 2, 3, 4, 5, 6, 7, 8, through which draw Right-lines, at Right-angles to 9 1, cutting the principal Rafter in the Points 10, 11, 12, 13, 14, 15, 16, and the Base of the Hip in the Points *h, i, k, l, m, n, o*. Make 1 25 equal to the Curve 1 10, also 1 24 equal to the Curve 1 11, also 1 23 equal to the Curve 1 12, *&c.* and through the Points 25, 24, 23, 22, 21, 20, 19, draw Right-lines, at Right-angles to 1 18; make 25 32 equal to *h* 2, 24 31 equal to 3 *i*, 23 30 equal to 4 *k*, 22 29 equal to 5 *l*, &c. and through the Points 32, 31, 30, 29, 28, 27, 26, from *a* to 18, trace a Curve, and make the Curve 18 *b* equal thereto; then will *a* 18 *b* cover one Side of the hexangular Roof; for,

for, as the Diſtances of the Points 25, 24, 23, *&c.* are equal to the Points 10, 11, 12, *&c.* in the Principal, and as the Points 25, 24, 23, *&c.* will lye perpendicular over the Points 2, 3, 4, &c. and as the Lines 32 25, 31 24, 30 23, are equal to the Lines *h* 2, *i* 3, *k* 4, &c. therefore *a* 18 *b* will exactly cover the part of the Roof over the Triangle *a* 9 *b*, and conſequently ſix of ſuch Pieces will cover the Whole. The other Roofs, Figures IV. V. VI. are covered by the ſame Rule, as is plainly ſeen by the ſeveral Lines in each Plan, but more particularly in Fig. V. where *f e* 15 is the Covering-piece to the Side *f b e*.

IN Plate CCCXCVIII. are nine Figures, which are as follow; Fig. I. repreſents a conical Roof on a Cylinder, and Fig. II. one 8th part of its Covering; Fig. III. repreſents a Bottle-roof, and Fig. IV. one 8th part of its Covering; Fig. V. repreſents a Bell-roof, and Fig. VIII. one 8th of its Covering; Fig. VI. repreſents a trumpet-mouth'd Roof, and Fig. IX. one 8th of its Covering.

To cover theſe circular Roofs.

RULE. Divide the perpendicular Height into any Number of equal parts, and through every of thoſe Points draw Right-lines parallel to the Baſe, which conſider as Diameters of ſo many Semicircles, which deſcribe, as *i r c*, *n q l*, &c. Fig. I. make *a b*, Fig. II. equal to the Side of the Cone *d c*, and divide *ab* in the ſame Manner, as *d c* is divided by the Semicircles; divide *r c* into 2 equal parts, and draw the Line *d m*, which will divide every of the Quadrants into two equal parts alſo; then make *l f*, Fig. II. equal to half *r c* in Fig. I. alſo *h i* equal to *q m*, &c. and the Figure *b l f* will be one 8th of the Covering required. It is here to be noted, that by this Method all other circular Roofs may be covered, it being a *General Rule*, and which I ſhewed here in the Example of covering the *Cone*, altho' I have already demonſtrated that Covering in a different Manner in Plate CCCLXX. Fig. VII. demonſtrates the Sections of a Cone by common Ordnates, of which ſee *Conick Sections*, in the *Index*.

Plates CCCXCIX. CCCC. *Demonſtrating the Proportions of Rooms.*

THE geometrical Figures, made uſe of for the Generality of Rooms, are, (1) The Circle, as *g*; (2) The Square, as *f*, Plate CCCC. (3) The Octagon, as *e*, and (4) The Parallelogram, as *d b f c a*, &c.

ROOMS, that are Parallelograms, are of divers Proportions, *viz.* (1) Their Length equal to the Diagonal of their Breadth, as *d b*; (2) To the Breadth and half, as *f*, and Fig. *b*, Plate CCCC. (3) To the Breadth and one 5th, as *d*, Plate CCCC. (4) To the Breadth and two 3ds, as *c*; (5) To the Breadth and three 4ths, as *k*, Plate CCCC. (6) To the double Square, or twice the Breadth, as *a*, and as *h*, Plate CCCC.

WHEN the Lengths of Rooms exceed twice their Breadths, they become Galleries, which may have their Lengths three, four, or five (but not more) times their Breadth, as Fig. *m o*, Plate CCCC.

AS Rooms are differently ciel'd, ſome being flat, and others arched, their Heights are therefore different.

GRAND Rooms with flat Cielings ſhould have their Heights equal to their Breadths, but where Grandeur is not to be ſtrictly obſerved, a leſs Altitude may be given, provided that the Breadth of ſuch Rooms be not leſs, than 16 Feet, when three 4ths thereof, *viz.* 12 Feet, may be taken for its Height.

THE Height of Covings to Rooms, whoſe Height is 25 Feet, or leſs, is one 4th of the total Height; but of Rooms, whoſe Height exceeds 25 Feet, as 30, *&c.* the Height of the Cove ſhould be one 3d of the whole Height.

HALF the Sum of the Length and Breadth of all Rooms, not exceeding the double Square, may be an eſtabliſh'd Rule for the Height of cov'd Rooms in general; and when their Lengths exceed the double Square, their Heights are

are to be confidered as the double Square; fo a Room 20 by 20 Feet, its Height muft be 20, being one half of 40; and a Room 20 by 25, whofe Sum is 45, gives 22 and a half for its Height; alfo a Room 30 by 20, whofe Sum is 50, gives 25, its half, for the Height; and a Room 20 by 40, whofe Sum is 60, and its half 30 is the Height. This laft being the double Square, its Height is the fame, as that of the Gallery *m o*, Plate CCCC. whofe Length is 100, and Breadth 20.

PALLADIO makes the Heights of his Rooms to be a mean Proportion between their Lengths and Breadths, as in Fig. B, Plate CCCXCIX. where *h k* being the Length, *k m* equal to the Breadth, the Line *k l* is a mean Proportion between them, and the Height affigned, which is fomething lefs, than the half Sum of the Length and Breadth, as aforefaid.

Plates CCCCI. CCCCII. CCCCIII. CCCCIV. CCCCV. *Acute, Right, and Obtufe-angled Brackets demonftrated.*

As I have fo largely explained the Formation of divers Curves by Ordnates, by which all thefe angled Brackets are found, it feems to be almoft needlefs to fay any thing hereon, the Whole being very plain by Infpection; but, that the young Student may not blame me, I will explain one Example, by which all the others are to be underftood.

Let e a b, Fig. III. Plate CCCCI. *reprefent a Front-bracket, whofe Curve e b, is fuppofed to ftand perpendicular over the Line e c, and let the Line d e reprefent the Bafe of the Angle-bracket.*

DIVIDE *e c* into any Number of parts, no matter whether equal or unequal, as at the Points *p, q, r, s, t, u, w,* and through them draw Right-lines parallel to *e* B, cutting the Curve of the Bracket in the Points *o, n, m, l, k, h, i,* and the Bafe of the Angle-bracket in the Points 1, 2, 3, 4, 5, 6, 7, from whence draw Right-lines at pleafure at Right-angles to the Line *e d*; make the Ordnates 1 8, 2 9, 3 10, &c. equal to the Ordnates *p o, q n, r m,* &c. and through the Points 8, 9, 10, 11, 12, 13, 14, from *e* to *g* trace the Curve of the Bracket required.

THE firft three of thefe Plates exhibit all the various Mouldings, Acute, Right, and Obtufe-angled, which in general have the Mould of their Brackets found by the foregoing Rule; as is alfo the *Tufcan* Cornice, in Plate CCCCIV. and CCCCV. The Figures B, C, are a Front and Angle-bracket, according to Mr. *Price*'s Method, which is as follows.

THE Fig. C being a Front-bracket, whofe Height is *n o*, and Projection *n m*, draw the Line *m o*, and parallel to *n o*, the feveral Lines *a* 1, *b* 2, *c* 3, *d* 4, &c. dividing the Line *m o* in the Points *a, b, c, d,* &c. meeting the Curve in the Points 1, 2, 3, 4, &c. The Angle-bracket is reprefented by Fig. B, where *o p* is the Height (equal to *n o*, the Height of Fig. C) and *o n*, its Projection; draw *n p*, and divide it into the fame Number of parts, and in the fame Proportion as *m o* in Fig. C, from whence draw Lines parallel to *o p*, and each refpectively equal to *a* 1, *b* 2, *c* 3, *d* 4, &c. of Fig. C, and through their Extremes 1, 2, 3, 4, &c. trace the Curve *n*, 11, 10, &c. *p*, which is the Mould of the Angle bracket required.

FIG. D is another Example of the fame kind. The Fig. E and F are Brackets to make lath'd and plaifter'd Cornices on. That of Fig. E is a Front-bracket, made fit to a propofed Cornice, and F is its Angle-bracket, which is made as follows: The Front-bracket being prepared, as in the Figure, and the Projection of the Angle-bracket being given or known, which here is *b g*, divide it in the fame proportion, as *m f* in Fig. E, as at the Points *c, d, e, f,* which are at the fame proportionable Diftances from each other with refpect to the Whole, as the Points 5, 6, 7, 8, in the Line *m f* are with refpect to that Whole; make the dotted Lines parallel to *b a* in Fig. F, whofe Heads

are

marked with *c, d, e, f,* equal to 5 *b*, 6 *c*, 7 *d*, 8 *e*, in Fig. E, and through their Extreams draw the Out-line of the Angle-bracket as required.

Plate CCCCVI. *The Formation of Centers for turning the Vaults of Arches on, in Brick or Stone.*

EXAMPLE I. Fig. A.

THE the Saliant Angles *a, b, c, d,* being work'd up with the Walls to the Height from whence the Arch is to ſpring, and the Curve of the Arch being determined (ſuppoſe) a Semicircle, as repreſented in the Section B, begin at *d e c*, and center it through as a common Vault, and board it. *To make the Groins*, ſet Centers, as from *a* to *c*, and from *b* to *d*; divide the Curve *d e c* into 4 equal parts, as at *g* and *f*; then is *g e f* a Mould for ſmall Centers, which will be wanted to nail on the Centers firſt boarded, whoſe Baſe is at *b*: Theſe ſmall Centers are to be put in at Diſcretion, as the bearing of the Boards may require. *To make the Groin ſtreight*, over its Baſe, at ſome little Height over the Centers, ſtrain a Line, as from *b* to *c*, or from *d* to *a*, from which, with a Plumb-line, drop Perpendiculars on the Boarding, (which is ſuppoſed to be firſt fixed) at as many places as neceſſary, and therein ſtrike Nails, to which apply a ſtreight and pliable Ruler or Lath to touch them, and, with a Pencil or Chalk, deſcribe the Curve, which will be a Semiellipſis, to which bring the Boards to be nailed on the aforeſaid little Centers, and their Joints will form a ſtreight Groin.

To cut the Angles of Boards, to cover any Center required, Fig. VIII. Plate CCCCVIII.

THE Plan *d a c b* is to be vaulted, with a ſemicircular Arch, from *a* to *d*, and an elliptical Arch from *b* to *a*. *To cut the Boards to cover this Center, let n be the Center of the Plan:* On one End, as *d c*, deſcribe the Semicircle *d g c*; continue out *c d* both Ways to *l* and *m*, ſo that *l m* be equal to the Circumference of the Semicircle *c g d*, and draw the Lines *m n* and *l n*; divide *m l* in ſuch manner as the breadths of the Boarding will allow, as the dotted Lines repreſent, and cutting their Ends to the Angles or Bevels of the Lines *m n* and *n l*, and their Lengths anſwerable to the Line *m l*, they will exactly cover that End of the Center, as required. In the like manner make *k i* equal to the Girt, or Circumference of the Semiellipſis *c f b*, and drawing the Lines *k n* and *n i*, and dividing *k i* according to the Breadths of the Boards, as was done with *m l*, the Angles or Bevels made by the Lines *k n* and *n i* are the Angles required for that Side, and ſo in like Manner all others.

EXAMPLE II. Fig. C, Plate CCCCVI.

AS this Plan is of greater Extent than the former, and if the Weight on it be great, it muſt not only have its Angles ſaliant, as the other, but projecting Piers, as *c e*, &c. and others entire in the middle, as *f l* alſo. The Section D ſhews, that the Length contains three Arches, and thoſe ſemicircular, wherefore their Groins, as *c e* and *a f*, &c. are ſemielliptical; by this Method the Arches will ſuſtain a very great Weight, with ſmall Abutments; but if thoſe middle Piers *f* and *l* are found inconvenient, and the Abutments can be made ſecure, then the aforeſaid Piers may be rejected, and elliptical Vaults turned both Ways, as the dotted elliptical Curves expreſs in D and E, which is equally as ſtrong as the former, and much more ſpacious, if the Abutments are made ſecure.

EXAMPLE III. Fig. G, Plate CCCCVI.

THE Length of this Plan hath an elliptical Vault, as demonſtrated by the

Section I. whose Height is regulated to the Height of the three semicircular Vaults that pass through its Breadth represented by Section II. which spring from the saliant Piers *b e*, *a d*, &c. in the Sides and Angles.

To find the Groins, perpendicular and streight over their Bases.

DRAW Ordnates in the Semiellipsis of Section I. at any Distances at Pleasure, which continue to meet the first Groin in G; make *n c* the Breadth of the Parallelogram L equal to the Circumference of the Semicircle *e f b*, in Fig. H; and *n e* its Length, equal to the Circumference of the Semiellipsis I, and draw *b e*, and *m* 9 in Fig. L; divide *m* 9 in Fig. L, in such Proportion, as 9 *m* in Fig. G is divided by the Ordnates being continued, and through those Points draw Right-lines parallel to *c n* both Ways at Pleasure; divide *e* 9 and 9 *b* each in the same Proportion, as *m* 9, and through those Divisions draw Right-lines parallel to *n e*, which will cut the others in Points, through which the curved Lines of the Groins must be traced, and thus will the Figure L represent the Sofito or Area of one of the semicircular Arches, pressed down on a flat Superficies. The Figure K represents the same of the whole being considered in Breadth only, supposing the Piers that sustain the Arches on each Side, were laid down at the Extreams of the Extent of the semielliptical Vault, when pressed down to a flat Superficies.

EXAMPLE VI. Fig. M, Plate CCCCVI.

THE Figure M represents the Plan of a Cieling, and Fig. O a Section of the Room it belongs to, whose Cove is one 4th part of the Height. As the Projections of the Coves are equal to their Heights, the Distance between their Projections, as *g h*, is the Breadth of the Pannel *g h*, in Fig M, and the same, being taken out of the Length, leaves *h k* for the Length of the Pannel; and as the Angle-brackets and Astragals are found by the preceding *Rules*, I don't see what more is to be done, or what Mr. *Price* means by Fig. P, or to what Use 'tis to be applied, which he calls, *the Face of* O, *as stretched, or extended out, on which any thing, proposed to be described therein, may be truly performed.*

EXAMPLE V. Fig. III. Plate CCCCVIII.

THE Example, given here by this Master, is in order to prove the necessary Abutments to large Arches, that thrust against small Arches, as the Arch L against the Side-arches M and N, and which he endeavours to proportion by the Height of the Curves of those Side-arches, as follows; *viz. Make the Height of the small Arches similar to that of the great Arch*; (which, says he, are the proper Curves, according to the Laws of Strength.) But herein I must ask his Pardon; for if the resisting Weight, laid on the Hanches and Piers, be not superior to the Thrust of the Scheme-part of the Arch, it cannot stand; therefore, let the Curvature of the small Arches be what it will, if the Weight of the Scheme of the great Arch be superior, they will rise up in their Tops, and permit the great Arch to fall down, as many have so done; and (if I mistake not) such was the Case in the vaulting of the new Church in *Spittle-fields*.

EXAMPLE VI. Fig. I. Plate CCCCVIII.

THE Plan O represents the Plan of a Cellar in a Dwelling-house, which is given to shew the Variety of Groins, whose Bases are expressed by the dotted Lines, and a Section of the Whole by Figure P.

EXAMPLE VII. Fig. CC, DD, *&c.* Plate CCCCVII.

THIS Figure represents the Manner of forming curved Groins, an Example of which may be seen in St. *Clement*'s *Danes*, *London*, and other Buildings of the like Nature, and (as Mr. *Price* observes) is a Work worthy of our Regard.

To find the Base of these Groins, (1) *a d b c* being the Plan, continue *a b* and

and $d c$, until they meet in a; divide $a b$ and $d c$ each into a like Number of equal parts, suppose ten; on the Point a, from every of those Divisions in $a b$, describe Arches to $c d$; divide the Arch $a d$ into the same Number of equal parts, as $a b$, viz. ten, as at the Points 1, 2, 3, 4, &c. from whence draw Right-lines to the Center a, which will intersect the aforesaid Arches in Points, through which the Bases of the Groins $b e d$ and $a e c$ must pass.

To describe the outward Ribs, these Ribs are to stand on the Lines $a d$ and $b c$, and have their Curves thus formed; make $a d$, in Fig. B B, equal to the Curve $a 5 d$; also make $b g$, Fig. E E, equal to the small Curve $b c$, and divide $a d$ and $b g$, each into 10 equal parts; the Side $a b$ of Fig. C C being divided into 10 parts, complete the Semicircle $a f b$, and draw its nine Ordnates; make the Ordnates on the Line $b g$, in Figure E E, and on the Line $a d$, in Figure B B, each equal to the Ordnates of the Semicircle $a f b$, and through their Extreams trace their Curves, and then B B and E E being bent, so as to stand on the curved Lines of the Plan $a d$ and $b c$, and the Semicircles C C and D D being set up over the Lines $a b$ and $d c$, they will be the Ribs proper to this Center, as required.

To find the Curvature of the Groins, make $a e$, Fig. Y, equal to the Curve $a e$ in the Plan; also make $b e$, Fig. A A, equal to the Curve $e c$ in the Plan, and divide each into 5 equal parts, from whence draw Ordnates, which make equal in each to those in the Semicircle, and through their Extreams trace Curves, and then $a e$, Fig. Y, being bent, and placed on the Curve $a e$ in the Plan, and $b e$, Fig. A A, on the Curve $e c$ in the Plan, their Curves taken together will be the true Groin, standing perpendicularly over its Base $a e c$, as required. The other for $b e d$ is found in the same Manner.

Plate CCCCVII. *Various Centers for Vaulting demonstrated.*

EXAMPLE I. Fig. O.

THE Plan $b a d c$ being a geometrical Square, and the Arches of both Vaults being Semicircles, therefore the Groin $d i a$ is a Semiellipsis, whose Length is equal to the Diagonal $d a$, and Height to $e f$, the Height of the Semicircle, and which is described by Ordnates, as the Figure expresses.

EXAMPLE II. Fig. P.

THIS Plan $a c b d$, being a Prallelogram, and the Arch of the Length of the Vault being a Semicircle, as $a e c$, therefore the Arch of the Breadth of the Vault $b h a$ must be a Semiellipsis, whose Length is equal to $a b$, and Height $h g$ to that of the Semicircle. The Groin $b m c$ is also a Semiellipsis, whose Height is equal to the former, and Length to the Diagonal $b c$, and are both described by the same Ordnates taken from the Semicircle, as the Lines demonstrate.

EXAMPLE III. Fig. R.

THIS Plan $b a d c$ is a geometrical Square, and the Arch of the Vaulting both Ways is a *Gothick* Arch. *To find the Curvatures of the Groins,* draw $d a$, which divide in such Proportion as you may divide $b a$; make the Ordnates on the Line $d a$ equal to those of $b f a$, and through their Extreams trace the Curves $d i$, $i a$, which are the Curves of that Groin; in like Manner find the others from b to c.

EXAMPLE IV. Fig. X.

IN this Plan $a c b d$, the Arch of the Length of the Vault $b h d$ is a Segment of a Circle, and that of the Breadth $b e a$, the Segment of an Ellipsis, as also is the Groin $a k d$, both which are described by equal Ordnates taken from those of $b h d$, as the Lines demonstrate.

EXAM-

EXAMPLE V. Fig. Z.

THIS Plan *d b a c* is a Rhombus, and the Arches of the Vaults both Ways are Semicircles. *To find the Curves of the Groins*, draw the Diagonals *b c*, and *a d*, divide each in ſuch Proportion as *b e a*, draw Ordnates in each, equal to thoſe of the Semicircle *b f a*, and through their Extreams, trace the ſemielliptical Curves *b n c*, and *a h d*, which are the Groins required.

EXAMPLE VI. Fig. W.

IN this Plan *b a d c* there is but one Vault, and that in length, whoſe Arch is a Semicircle *b h c a*. It is ſuppoſed that in its Sides there are to be ſmall Arches made, over the Heads of two Doors or Windows, which will interſect the great Arch of the Vault at Right-angles. *To find the Curves of theſe ſmall Vaults, which they make with their meeting of the great Vault*, proceed as follows: Let 1 *t* repreſent the Breadth of the Window, or ſmall Vault, which biſect in *y*; draw the Ordnate *h g*, in the Semicircle, equal to *y t*; alſo make *r* 1 and *u t* equal to *y t*, and draw *r u*; draw *z y* at Right-angles to *b d*, continue *h g* to *x*, or to meet *z y* continued in *x*, then drawing 1 *x* and *t x*, the Triangle 1 *x t* will be the Plan of the ſmall Vault; make *x w* at Right-angles to *x t*, and equal to *z y*; divide *b g* into any Number of parts, and draw Ordnates to the Arch *b h*; divide 1 *y*, *y t*, 1 *x*, *x t*, each in the ſame Proportion as *b g*, and making their Ordnates equal to thoſe of *b h g*, throught their Extreams trace the Curves *z*, *z t*, and *t w*, which are the Curves of the Arch or ſmall Vault, as required; for if the Arch 1 *z t* was raiſed perpendicular over 1 *t*, it would be the grand Rib of the ſmall Arch, and if the Curve *t w* ſtood perpendicular over the Line *t x*, it would be the Groin meeting the great Vault, as having equal Ordnates; the Triangle 2 *o k*, on the Right-hand Side of this Figure, is a leſſer Arch than that deſcribed, which hath its Groins found as in the other; the like is alſo to be obſerved in Fig. S, where the Arch of the great Vault is a Semiellipſis, which is interſected in its Sides by ſmall Vaults, whoſe Plans are 1 *x t*, and 2 *o k*. For the Deſcription of Figures A, B, C, D, E, F, G, &c. ſee the Word *Vaults* of *Brickwork* in the *Index*, where their Manner of working is deſcribed at large.

THE Figures IV. V. VI. VII. demonſtrate the Pitch, and Mitre-joints of Pediments, of which ſee the Word *Pediment* in the *Index*.

Plates CCCCIX. CCCCX. CCCCXI. *Deſigns for Cieling-pieces after the ancient Manner.*

IN theſe three Plates are contained eleven Deſigns for Cieling-pieces, by *Sebaſtian Serlio*, wherein are ſome, which modern Architects have not exceeded, and which are very helpful to Invention.

Plates CCCCXII. CCCCXIII. CCCCXIV. *Seven Deſigns for Cieling-pieces, by* I. JONES.

THESE Deſigns, being of grand parts, and thoſe not crowded with Ornaments, demonſtrate the great Judgment of this Maſter in Decorations of this Kind, and which, in general, are worthy of our greateſt Regard and Conſideration.

Plates CCCCXV. CCCCXVI. *Modern Deſigns for Cielings.*

IF we compare the three Deſigns in the firſt of theſe Plates with thoſe of Plates CCCCIX. and CCCCXI. we are then informed, that theſe Deſigns were ſtolen from *S. Serlio*, and indeed, if we compare thoſe on Plate CCCCXVI.

with

with them of *Inigo Jones* in the preceding Plates, we are alſo informed, that his Manner of dividing out the Pannels were borrowed from that Maſter, but not his Ornaments, which I think are too numerous, and therefore leſs noble. Indeed, I muſt own, that the Proportions and Profiles of thoſe in Plate CCCCXV. are very inſtructive to the Workman, and which are Improvements on *Serlio* worthy of our Thanks.

THESE Deſigns may be executed either on flat or curved Cielings, but in both Kinds it is to be obſerved, that the nearer the Cieling is to the Eye, the leſs the Mouldings and Ornaments muſt project: For if the Mouldings and Ornaments of a Cieling 12 Feet high, were made as prominent as thoſe to a Cieling of 20 Feet high, they would appear, as Weights, almoſt inſupportable, and give Offence, inſtead of Pleaſure, to the Eye; therefore, herein, Diſcretion is abſolutely neceſſary.

Plate CCCCXVII. *Demonſtrating the Ornaments of Cupola's, and Circular Sofito's.*

ADMIT the Line D in Fig. I. whoſe Length is divided into 14 parts, repreſent the Breadth of one Side of an octangular *Cupola*, whoſe Centre is C; from whence draw Right-lines to its Extreams, and the Iſoceles Triangle formed thereby, will repreſent the Plan of one 8th part of the *Cupola*. Make A B, Fig. II. equal to C D, and on A, with the Radius A B, deſcribe the Quadrant C B; divide the upper half of the Line D into 7 equal parts, as at the Points 1, 2, 3, 4, 5, 6, 7, D, and from the Points 1 and 4, draw Right-lines to the Centre C; make B 1, in Fig. II. equal to 4 of the 7 parts into which the half of D is divided; and from the Point 1, draw the Line 1 G parallel to A E B, and alſo the Line 1 2 2 parallel to B B; make the Diſtance 1 2 in the Arch C B, Fig. II. equal to the Diſtance 2 2 in Fig. I. and from the Point 2, draw the Lines 2 G and 2 3 3, parallel to the Lines A B and B B as before; alſo the Diſtance 2 3 on the Arch C B, Fig. II. equal to 3 3 in Fig. I. and from thence draw the Lines 3 G and 3 4 4, parallel to A B and B B: And ſo in like Manner proceed to ſet up on the Arch C B, the Diſtances 3 4, 4 5, 5 6, 6 7, and 7 8; from whence draw Right-lines to meet D C, the central Line of Fig. III. which is the Upright of this 8th part of the *Cupola*, whoſe Breadth B A, is equal to the Line D in Fig. I. and Height to A C Fig. II. and whoſe Ordnates, through which its Curve paſſeth, are taken from, and are equal to thoſe dotted ordnate Lines in Fig. I. which are parallel to the Line D, and included between the Sides of that Triangle, which proceeds from the Centre C. The horizontal Diſtances of the Angles of each Pannel are alſo determin'd by Curves, trac'd through Points found in this Manner, from the inner Diviſions of the Plan. The Figures H, I, are two Sides of the ſame *Cupola*, but differently adorned, they being divided into Hexagons and Octagons, and this into geometrical Squares. The Figures K, L, M, repreſent the Sofito's of Arches divided into Pannels, wherein 'tis always to be obſerved, that they conſiſt of an odd Number, that thereby one may be directly in the Vertex, and the others equally on each Side. The Border muſt be not more than one 6th, nor leſs than one 7th of the whole Breadth. The concentrick Arch F E in the Profile Fig. II. on which the Pannels of this ſemicircular Sofito are divided, will be fully ſufficient to demonſtrate them. The two ſemicircular Sofito's O, N, are of a greater Breadth, and given as Examples to ſhew how they may be adorn'd.

Plate CCCCXVIII. *Ornaments for coved Cielings.*

HERE is repreſented ſix different Ways of adorning coved Cielings, under which are their Platforms enrich'd; the upper two are with Groins, which have a very pleaſing and beautiful Appearance. Theſe Coves are gene-

rally made to be a 4th part of a Circle, and adorned with Fret-work or Painting, and oftentimes with both.

Plate CCCCXIX. *Ornaments for the Infides of Cupola's, and Circular Sofito's.*

HERE are eight good Defigns of Ornaments for the Infides of *Cupola's*, whofe Heights and Breadths are found by the foregoing Rule; as alfo feven Defigns for *Circular Sofito's*, with 3 Defigns of Rofes for Pannels.

From Plate CCCCXX. to Plate CCCCXXVIII. inclufive. *Defigns for Chimney Pieces.*

IN thefe nine Plates are contained twenty two Defigns for Chimney-pieces, of which the largeft in every Plate are by *Serlio*; the four Defigns on the left of Plate CCCCXXIII. and thofe of the Bottoms of Plates CCCCXXV. and CCCCXXVI. are by *Inigo Jones*, and which in general are good Defigns. The other Defigns at the Bottoms of Plates CCCCXXI. CCCCXXII. CCCCXXIV. CCCCXXVII. CCCCXXVIII. CCCCXXX. and CCCCXXXI. are Defigns by Mr. *Kent*, to which he has made fmall raking Pediments, which are not only improper Members to fuch Ornaments, but, by their extraordinary Projectures, have falfe Bearings, renders the Mantles ufelefs, and deftroys the Magnificency of the Entablatures, which ever ought to be entire. As Pediments are Ornaments adapted to carry off Rains from Portico's, *&c.* 'tis abfurd to introduce them where Rains do not come. If we compare thefe *Kentifh* Defigns with thofe of *Serlio*'s, which are truly grand and magnificent, we fee immediately, that they are nothing more than fo many taftlefs *Whims of poor Invention.*

From Plate CCCCXXIX to CCCCXXXIV inclufive. *Defigns for Chimney Pieces, by other Mafters.*

THE firft of thefe Plates reprefents four Defigns for Chimney Pieces by *Vincent Scamozzi*, of which I cannot recommend the upper and lower ones; that above, having the Range of its Entablature broken by a projecting Table, as if thereon an Infcription was intended; and the other for its Pediment, which, like thofe of Mr. *Kent*'s, has a poor nigard Look, and feems to have been taken from the Form of an old Woman's Forehead-cloth. The other two half Defigns are very good, as likewife would the upper one in Plate CCCCXXXI. be, which is by *M. J. Barozzio* of *Vignola*, was but that *Gothick* Table in its Freeze removed, fo that its Freeze might be entire. In Plates CCCCXXXII. CCCCXXXIII. and CCCCXXXIV. are twelve Defigns for Chimney Pieces, by Mr. *Gibbs*, of good Invention. The firft three Chimney Pieces in Plate CCCCXXXII. have Pannels over them with broken Pediments, and which are much more proper for infide Ornaments, where no Weather comes, than abroad, where, by their being open, they are ufelefs. The next three Defigns in Plate CCCCXXXIII. have alfo Pannels over them with raking Pediments, and tho' they cannot be faid to be perfectly properly introduced, for the Reafons aforefaid, yet, as they crown the Whole, and in fome Meafure protect the lower parts from the perpendicular Fall of Duft; and as they fpan each Defign, and are of grand parts (not poor and little, as thofe of *Kent*'s) they are worthy of Efteem. In the laft of thefe Plates are fix Defigns, by the fame Mafter, which are in general very good. The upper three are fquare, and their Architraves one 6th of their Aperture; the Apertures of the other three vary, as the Divifions exhibit. To each Defign is a Scale, by which the Proportions of their Heights and parts may be very accurately determined.

Plates

Plates CCCCXXXXV. CCCCXXXVI. CCCCXXXVII. *Exhibiting Plans and Sections of ftrait and cylindrical Stair-cafes*

THE upper Figures *i s, e o, a k,* reprefent a Section raifed from the Plan *m k a c,* which is the Plan of a ftrait, but double Stair-cafe, whofe Extreams are at *a* and *k,* its half Paces at *l b,* and landing Places at *m* and *c.* The lower Figures *c c* and *d d,* reprefent the Plans and Sections of two cylindrical Stair-cafes, whofe Difference confifts chiefly in the Form of their Steps; that of *c* being ftrait from the Centre, and the other circular, which laft has not only a Beauty, but a greater Length than thofe of *c.* Thefe Kinds of Stairs are made, either to wind about a folid Cylinder, (which fome ignorantly call a Column) as *d c* in Plate CCCCXXXVI. or with an open Newel, as herein is reprefented, and which in large Stair-cafes is very convenient, as well as beautiful, to admit Light from above to the lower parts. The Diameter of the Cylinder, about which the Stairs wind, muft not be lefs than one 6th, nor more than three 7ths of the Diameter of the Stair-cafe. But I think the moft beautiful Proportion is, to divide the Diameter of the Stair-cafe into 4 equal parts, give two to the Column, or Well-hole, and the other two to the Steps. The uppermoft Figure in Plate CCCCXXXVI. is a Plan and Section of a beautiful and grand cylindrical Stair-cafe, made by Order of *Francis* I. King of *France,* at *Chambor,* a Palace erected in a delightful Wood. This Stair-cafe is quadruple, having four Entrances, as at *a l f q,* which afcend the one over the other in fuch a Manner, that, being made in the Centre of the Building, they lead to four Apartments, each at 90 deg. Diftance; fo that the Inhabitants of one Stair-cafe, need not go down thofe of the other; and, as it is open in the Middle, they may all fee each other afcend and defcend, without being in the leaft incommoded. The Figures *e e* and *f f,* Plate CCCCXXXVII. are the Plans and Sections of elliptical cylindrical Stair-cafes, which are proportioned in the fame Manner as the aforefaid; the other two Figures are cylindrical Stairs alfo, of which the lowermoft is a double Stair-cafe, winding about a Cylinder in fuch Manner, that two Perfons, afcending together in equal Times, will never fee or meet each other, and yet be always of equal Height above Ground. A Stair-cafe thus made would lead to two feparate Apartments, in as private a Manner as two diftinct Stair-Cafes could do.

CIRCULAR Stair-cafes are ufed either for Grandeur or Conveniency; when they are ufed to exprefs Grandeur, they muft be fpacious, as in the foregoing Example in Plate CCCCXXXVI. but when for Conveniency only of going up in a little Space, they muft be made much narrower. In the Formation of fuch fmall Stair-cafes it is to be obferved, that the Breadth of the Treader of each Step, at about 20 Inches or 2 Feet Diftance from the Middle of the Rail, be not lefs than 9 Inches, nor more than 15 Inches as aforefaid; becaufe, as in going up and down, the Hand being generally on the Rail, the Feet travel at about that Diftance from the Middle of the Rail's Bafe. It is alfo abfolutely neceffary to make *Quarter* Paces, for Eafe in going up, as well in thefe, as in other Kinds of Stair-cafes, which, if placed at proper Diftances, fo as not to obftruct the Head-way under them, will be found very ufeful. The Plans C, B, A, D, H, in Plate CCCCXLII. have the Breadths of their Treaders proportioned as aforefaid; but the Plan F, which is an Ellipfis, is varied a little, the Curvature being much quicker towards the Ends, than in the Side.

Note, Thofe of A and B may be lighted from above; thofe of C F D by fide Lights, *&c.* The Plans E, I, G, are recommended for Buildings, wherein are half Stories, called *Mizzano*'s. The Plan G H feems to be of pretty Invention, having the fmall Stair-cafe H for the Ufe of Servants in its Vacuity. The Section T, Fig. II. is taken from the Plan D, exhibiting the Meeting of the Steps and String-board, wherein at *d c, e b,* is fhewn the ill Effect of placing

ing circular taper Steps with parallel Steps, which the fudden Turn at their meeting occafions, and which caufes the Figures of the String and Rail to be not the moft agreeable, if not worked by a judicious Hand, that can humour their meeting with Difcretion. The Section G is taken from the Plan C, which confifts of two Quadrants, on which the Steps are equally divided; the Right-lines *a, a, a, a,* are each equal to the Curves of the Quadrants in the Plan; fo that being bent to the Curvature of the Plan, they become circular and twifted every Way. The Section H K I is taken from another Plan of the fame Kind, as the Plan C, wherein at M the Doors and Windows in the Wall being exprefs'd, and the Profile of the Steps, as well for the fecond as the firft Floor, you are thereby fhewn the Space for Head-way, which is a material Point, as this Mafter obferves, and greatly affiftant to thofe of fmall Experience.

Plates CCCCXXXVIII. CCCCXXXIX. *Exhibiting Plans of mixt Stair-cafes.*

MIXT Stair cafes are fuch as be partly ftrait, and partly circular, as *b*, Plate CCCCXXXVIII. as D, Plate CCCCXLII. and A, Plate CCCCXLIII. The upper Figure *a* 3, in Plate CCCCXXXVIII. is a Section of the half Plan *a* 1. The Figure 3 *b* is a Section of the half Plan *b*, of a grand Stair-cafe and circular Portico; the upper part of this Plan, marked 2 *b*, is the Plan of the upper part over the Plan *b*. The Figure *c* is the half Plan of another mixt Stair-cafe; the part on its left, marked 2 *c*, is the Plan of the upper part of the fame. Figure 3 *c* is its Section length-wife, and Figure 4 *c* its Section breadth-wife. Thefe Examples being given for Practice, the young Student muft obferve in performing them, to make each complete (not in half) that thereby he may be the better able to judge of their Effects.

In Plate CCCCXXXIX. are fifteen Figures. In that marked A, the part *a* reprefents the ground Floor, *b* the Afcent of the Stairs, wherein 'tis fuppofed the Strings and Steps of Stairs are contained; and *c*, a horizontal half Pace. In Fig. B, the parts *a, b, c,* reprefent the Floor, Afcent and half Pace, as in Fig. A; the parts *d, d,* the Space for an Architrave; the parts *e, e, e,* the Bafe to the Ballufters; *f, f, f,* Newel-Pofts; *g, g,* the Hand-rail, under which are placed the Ballufters. The Fig. C is a Reprefentation of Figures A and B, as when completed with its Mouldings, *&c.*

To defcribe the Plan of a Stair-cafe, Fig. Z.

(1) Let C D A B be the internal Angles of a Stair-cafe, the Length of whofe Steps (which fhould never be lefs than three feet) are equal to one 4th part of the Breadth, and whofe Bounds are the Parallellogram H I G F, within which, defcribe the Breadth of the Ornaments, *viz.* the Balluftrade, Hand-rail, *&c.* as *h i g f*. (2) Confider the Height of the Story, and the Number of Steps neceffary to afcend its Height; wherein obferve, that the Height of Steps fhould never be lefs than 5 Inches, nor more than 7 Inches; and that their Breadths fhould never be lefs than 9 Inches, nor more than 15 Inches (fome fay 18 Inches, but I think 'tis 3 Inches too much.) (3) Suppofe the Height of this Story be 9 Feet 4 Inches, then 16 Steps of 7 Inches each will rife to that Height. (4) Set out the Breadth of the Steps, and confider how many Steps can be had in the Length G H for the firft Flight, which fuppofe to be fix; thefe fix divide into Halves, which call twelve, and fetting 1 of thofe Halves off from the Angles G and H, with the other ten Halves defcribe five Steps, which draw through the Plan, fo as to divide the Side I F into the fame Number of Steps. (5) Proceed in the fame Manner to defcribe the Steps at the Return H I, which fuppofe to admit of four Steps, and fet off the Breadth of half a Step from each Angle, and defcribe three Steps, which produce to the Line C D, and thus is the plan completed. *Note*, 'Tis beft to divide the

Heights

Heights of the Steps exactly on a Rod ; and that the Height or Rise, and the Tread or Breadth of a Step, is called a Pitch-board, whose Use will be hereafter explained.

To raise the Section or Upright of each Flight.

(1) CONTINUE out every Step, and make *e b* equal to the Height of the first five Steps ; divide *e b* into 5 equal parts, from whence draw Lines parallel to C B, and they will determine the Height of every Riser, and Length of every Treader in that Flight. (2) Draw *d h* parallel to C D, at the Distance of *e b*, and from *h* set up the Risers and Treaders of the Flight from H to I. Continue C D to *d*, making D *d* equal to D *d*, in the Line A D continued ; and from *m*, set up the Risers and Treaders of the Flight from I to F ; and thus will the Upright of each Flight from the Ground be completed.

THE Figure D is an irregular Stair-case, whose Plan is a Trapezium *b c d a*, wherein observe, that if from the Angles Perpendiculars are drawn, as *i c*, *c h*, and *d g*, *d f*, also *k b* and *a e*, and the Steps being divided as before, leaving the Distance of half a Step from each Perpendicular, the Whole may be completed in the same Manner.

FIG. E represents the usual Method, where the Quarter Paces are made square to the Angle of the Newel, which occasions the Hand-rail of the first Flight to drop below the Rail of the second by the Height of three Steps, and so the same in all other Flights.

FIG. F exhibits the Stair set to the Middle of the Newel, which drops its Rail the Height of two Steps below the Rail next above it ; and so in like Manner that of G, where the Stair is placed to the Outside of the Newel, the Drop of the Rail is but one Step ; and lastly, that of H, having its Stair set half a Step clear without Side the Newel, brings the Rails to meet, as in Figures B and C.

TO the Figures I and K are large Mouldings, as *a a*, and to preserve the Regularity here, as in the last, set the Step the Breadth of half a Step on the Outside of the Moulding. It is also to be observed, that a half Ballufter is often joined to the Newel, and whenever it happens that the Interval or Space is too great for a half Ballufter, then the Newel may be augmented, as at *b b* in Fig. K.

FIG. L represents the regular Method, and Fig M the irregular Method, of joining Rails and Ballufters, which last, tho' done in the new Stair-cases at the West End of the Parish Church of St. *Martin's in the Fields*, by Direction or Permission of Mr. *Gibbs*, yet it is a Practice to be abominated by every Artist, and what none would do or suffer to be done that knows how to do better. The Figure N exhibits the Manner of continuing Lines from a regular Ballufter, for the dividing of the Parts of a raking Ballufter.

LASTLY, Fig. O is a Plan of a Stair-case of five Flights, fitting for a very lofty Story, whose middle Flight is made larger than the others, as being more convenient and grand.

Plates CCCCXL. CCCCXLI. CCCCXLII. CCCCXLIII. *Exhibiting Plans of Right-angled Stair-cases, with the Manner of kneeling, ramping and squaring twist Rails, fluting Newels, &c.*

THE Plan A, Fig. III. Plate CCCCXLI. consists but of two Flights, and therefore is called *Dog-legged*, wherein *b c d* represents Door-ways, and *e* a Window for Illumination. Right-angled Stair-cases are either Geometrical Squares, as Figures G, H, Plate CCCCXLIII. or Parallelograms, as A B in Plate CCCCXLI. The Plan B, Plate CCCCXLI. hath an *open Newel* (as the Space B) which consists of three Flights, wherein *f n m l k* are Door-ways, and *g h i* a *Venetian* Window to illuminate it. It is to be observed, that when Stair-cases are made with open Newels, as in this Example, they may be illu-

 minated

minated from above by Means of *Lanthorns*, *Cupola's*, &c. when the Sides will not admit Light, as in this Example; and therefore if a Stair-cafe be but fpacious, and conveniently fituated, we need not regard whether it is illuminated from its Sides or from its upper Parts.

QUADRANGULAR or geometrical fquare Stair-cafes, as G H, Plate CCC[illegible]II. have their Steps divided into three or four Flights, as the Space and Height of the Story requires. The Length of the Steps, as I before obferved, fhould not be lefs than three Feet, and is moft beautiful when each is equal to one 4th of the Breadth of the Whole. In the Figure G, it is fuppofed that there is a Wall within Side, from whence it receives the Light, but that of H hath an open Newel.

THE Section B, Plate CCCCXLIII. reprefents a Stair-cafe of the *Dog-legged* Kind, whofe Steps are on Strings of Wood, which are cafed underneath to reprefent folid Steps: In Stair-cafes of this Kind 'tis fometimes neceffary to put Steps in the Quarter Paces, which ought not to exceed four in Number, unlefs the Stairs are very large, *viz.* where the Length of the Step is four Feet divide it into four Steps; where five Feet into five Steps, and where eight or nine Feet into twelve Steps; but indeed in large Stair-cafes it muft be avoided, if poffible, becaufe fuch refting Places are not only ufeful, but very grand alfo. Thus much with refpect to the Formation and Difpofition of Stair-cafes, the next in Order is their Ornaments.

To find the Kneeling and Ramp of Rails, Plate CCCCXLI.

AT C in Fig. II. is exhibited a fhort Flight of four Steps, and part of a half Pace; the Height *a b* is the Height of the firft Step, on which ftands the Newel *b c* and the firft Ballufter *o*; the Heights and Breadths of the other Steps are expreffed by the dotted Lines, on each of which are placed but two Ballufters. The Height of the Newel may be from two Feet and four Inches to two Feet and fix Inches, *&c.* and *c d*, the Thicknefs of the Rail, is at Pleafure.

THE horizontal part of the Hand-rail *c o* is called the Kneel, whofe Joint is at *o*, the Middle of the firft Ballufter. The Height of the Plinths to the Ballufters is equal to the Height of the Steps, and their Breadth to one 4th part of the Breadth of a Step; as alfo is *f e* the Plinth of the Column on the half Pace, whofe Column *f g* is equal to the Column *b c* on the firft Step. The Height of the Hand rail at *h g* is alfo equal to its Height at *d c*, and the Length of the horizontal Hand rail *i h* is generally equal to the under part of the Kneel *c o*.

To find the Center of the Ramp.

THE Arch *n i* is called the Ramp, whofe Center *k* is thus found: Continue *h i* towards *k*, &c. at pleafure, from which find, with your Compaffes, the neareft Diftance to the upper part of the ftrait Rail, that, when turn'd up, fhall meet the Line *h i* in *i*. Now it is to be here obferved, that as the raking Line of the ftrait Rail, (but not the Point *n* therein) and the Point *i*, with the Line *h i* continued, are given, to find the Points *k* and *n*. I muft own, I do not know any Propofition in *Geometry*, that will determine thofe two Points; and therefore, the Point *k* muft be found by making divers Effays, by moving the Point of the Compaffes either backwards or forwards on the Line *h i k*, until the other Point extended to the ftreight Rail, which will, when turn'd up, fall on the Point *i*. When *k* the Center is fo found, let fall from thence a Perpendicular to the raking Rail, as the Line *k n*, then will the Point *n* be the Point from which the Ramp afcends.

IF 'tis required to have three Ballufters on each Step, then the Kneeling at *t p* and *q s* fhould come to the backfide of the firft and laft Ballufters, as at *p* and *q*.

To

To find the Height of the Ramp.

LET *z* repreſent the Hand-rail, whoſe bottom is continued out both ways to *u* and *w*, make *w x* equal to *u t*, and *x y* equal to the Height of a Step; then is *y* the Height of the lower part of that Kneel, and *q y* is equal to the Interval between the Plinth of the Balluſter, and the Riſer next to it. Having proceeded thus far, you muſt draw *r s* parallel to *q y*, at the Diſtance aſſigned for the Height of the Rail; alſo, draw the upper part of the raking Rail parallel to *p w*. Now, to deſcribe the Ramp, and thereby find the Point *r*, continue out the Line *r s* at pleaſure towards the left, and from thence take the neareſt Diſtance to the Line *p w*, ſo that the extended Point of the Compaſſes, when turned up, ſhall fall in the Point *q*; then will the other Point, in the Line *s r* continued, be the Center of the Ramp, and which will determine the Point *r*; alſo, by the upper Arch of the Ramp, being deſcribed from the upper part of the raking Rail.

THE Figure D repreſents the manner of fluting Newels and Balluſters for Stairs. The Semicircle marked * hath ſix Flutes, and is for Newels; the other Semicircle hath but four, and is for Balluſters: But where Newels and Balluſters are any thing large, inſtead of giving twelve Flutes to the Newels, and eight to the Balluſters, the Newels may have ſixteen, and the Balluſters twelve, the Whole being always at the Diſcretion of the *Architect*.

The Manner of deſcribing Scrolls, for the Plans of twiſted Rails. Fig. I. Plate CCCCXLI.

FIRST Sketch out with Chalk, *&c.* a Scroll proportionable to the Place in which it is to ſtand, and determine on the Bigneſs of the Stuff to be uſed, and the Kind of Mouldings on the Side of the Rail; which, for Example's ſake, we'll ſuppoſe to be as repreſented in Fig. C. *Secondly*, On the Center of the Eye of your chalk'd Volute deſcribe a Circle, whoſe Diameter make equal to *g f* in Fig. C, and, concentrick thereto, deſcribe another, as *h*, ſo that *h g* be equal to half *g e* in Fig. C; then will this laſt Circle be the Bigneſs of the Eye in the Scroll. *Thirdly*, Set one Foot of your Compaſſes in the Center of the Eye, and extend the other to *k*, the Inſide of the Rail, and, with that Radius, deſcribe the Circle *k l w*, which divide into 8 equal Parts, as the dotted Lines expreſs; draw the Line *k l*, and on the Point *k* deſcribe the Arch 1 2 3 4 5 6 7 8, from the Point where the Line *l n* cuts the out Circle of the Eye; which Arch divide into 8 equal parts, as at the Points 1, 2, 3, 4, &c. and from the Point *k* draw the Lines 1 1, 2 2, 3 3, 4 4, &c. which divide the Line *l n* at the Points *m*, *n*, *o*, *p*, *q*, *r*, *s*. *Fourthly*, Take the Diſtance *l m*, and ſet it on the Line *q m*; from the out dotted Circle to the Point *m*. In like manner ſet the Diſtance *l n* on the Line *i n*, from the out dotted Circle to the Point *n*; alſo ſet the Diſtance *l o*, on the Line *o s*, from the out-dotted Circle to the Point *o*; and ſo in like manner, ſet off the Diſtances from the out-dotted Circle on the Lines *p k*, *q m*, &c. Diſtances equal to *l p*, *l q*, *l r*, and *l s*; and then will the ſeveral Points *m*, *n*, *o*, *p*, *q*, *r*, *s*, *t*, be the Points, through which the Out-line of the Scroll muſt paſs, and which is deſcribed by eight Centers, as follow: Take the Diſtance from *k* to the Center of the Eye, and with that Diſtance, on the Points *m* and *k* deſcribe a Section of two Arches, whoſe Point of Interſection is the Center of the Arch *m k*. This done, take the Diſtance from the Point *m* (in the Line *q m*) to the Center of the Eye, and, with that Diſtance, on *n* and *m* deſcribe a Section of two Arches, as before, whoſe Point of Interſection is the Center of the Arch *n m*; proceed in like manner to find the other ſix Centers, on which deſcribe ſeveral Mouldings concentrick to the Out-lines, whoſe Sections do not terminate, or meet each other at the eight dotted Lines, as the Out-line did, but at thoſe Lines, that are drawn from the Points *m*, *n*, *o*, *p*, &c. to the Centers of the Arches *k m*, *m n*, *n o*, &c. As I have thus explained the Conſtruction of

this

this Scroll, which this Maſter has omitted, I may venture to refer the Reader to the Inſpection of the other Scroll, Figure E, as being deſcribed by the ſame Rule, altho' it conſiſts of two Revolutions, or Turnings about, and is therefore made from a Diviſion of 16, as the other was from a Diviſion of 8.

To ſquare a twiſted Rail, Plate CCCCXL.

(1) THE Out-lines of F, Figure V. are the ſame of Figure D in Plate CCCCXLI. whoſe Centers are the Points 1, 2, 3, 4, 5, 6, 7, 8, that form a Circle in the Eye of the Scroll; and as the Center 2 is the Center of the Arch *b* 2, therefore from the Center 2 to *b* draw the Line *d b*. (2) From the Plan *d c b a* trace the Mould K, Fig. IV. whoſe Curves ſhall ſtand perpendicularly over thoſe in the Plan F, when applied on the Rake, which is traced as follows, *viz.* 1*ſt,* Obſerve, that as the twiſted part of the Scroll begins at *a,* and ends at *n,* therefore, in Fig. M, make *n a* equal to the Curve *a n* in Fig. F; in like manner, make *o c,* Fig. N, equal to the inward Curve *c d,* &c. in Fig. F. I have already ſpoken of a Pitch-board, which is nothing more, than a Right-angled plain Triangle, as I, whoſe Baſe is equal to the breadth, and its Perpendicular to the Height of a Step. Make *g e,* in the Step-mould, equal to *a e,* in Fig. F, and draw *e i* in the Pitch-board parallel to its Perpendicular; on the Points *a* and *c,* in the Figures N and M, erect Perpendiculars, each equal to *e i* in the Pitch-board; alſo make *a e* in Fig. M, and *c d* in Fig. N, equal to *g e* in the Pitch-board, and draw the Line *e r p* in Fig. M, and *d s q* in Fig. N; divide *n e* and *e r* in Fig. M, and *o d* and *d s* in Fig. N, each into 8 equal parts, and draw the interſecting Lines in both, by which their Curves are generated. The Curve in M, at *b t,* ſhews how much Wood is wanting on the back of the Rail, which ſet from *e* to *a* in Fig. L, and there deſcribe the bigneſs of the Rail; the other part of the Twiſt is cut out of a parallel Piece, as Fig. O. It is alſo to be noted, that the under part of the Rail will be deficient of Wood, as at *g h.*

THE aforeſaid Wood being made good on the Top and under part of the Rail, make *k i* in K equal to *g i* in the Pitch-board, and *k l* in K equal to *e b* in F, and draw the Line *i l*; make *g d* in the Pitch-board equal to *d b* in F, and draw *d m* parallel to *i e*; make *l m* parallel to *k i,* and equal to *g m* in the Pitch-board, and make *m p,* in K, parallel to *k l,* and equal to *d f,* in F; draw Ordnates at pleaſure, either equidiſtant, or otherwiſe, in F, from the Lines *c f* and *d f* to the Curve *d c,* and from the Lines *a e* and *b e* to the Curve *b* 2 *a*; divide the Lines *i k* and *k l,* in K, in the ſame Proportion, as *a e* and *b e,* in F, and making the Ordnates equal, trace the Curve *i l* in K; and then, dividing *p m* and *o p,* in K, in the ſame Proportion, as *c f* and *d f* in F, make thoſe Ordnates in K equal to thoſe in F, and trace the Curve *o m,* which compleats the raking Mould K, whoſe Curves (when in their Places) will ſtand perpendicular over the Curves in the Plan F, as required.

TAKE the Raking Mould K, and ſet the Point *i* to the Point *f* (in L) and there ſtrike it: Wherein obſerve, that the Angle *f* (in L) muſt be made equal to the Angle *m* (in the Pitch-board) or applying the Angle *m* of the Pitch-board to the Point *f* (in L) with the Hypothenuſe *g m* of the Pitch-board, to the Line *f e* (in L) draw the Line *f* by the Perpendicular of the Pitch-board. At the Bottom of the Rail apply the Mould K, ſet *i* to the prick'd Line, and there deſcribe it with your Pencil; laſtly, cut that Wood away, alſo cut the remaining part of the Scroll out of the Block (as) O, then glue theſe together, and binding both the Moulds M and N round the Rail, ſtrike them and cut away the Wood; ſo will the Back of the Rail be ſquared, as required.

To set out the Distances of the Ballusters on the twisted Rail, Fig. VI. Plate CCCCXL.

THE Scroll U is of the same Magnitude as that of F, and Q P represents the first two Steps in this Figure, as H G doth in F. The Pitch-board R is also equal to the Pitch-board I. Before the Distances of Ballusters can be set out, their Bigness must be determined, which, for Example sake, we'll suppose to be *a*, *b*, *c*, *d*, *e*, *f*; for the more exact Division of the Ballusters, 'tis best to describe a Line through the midst of the Rail, and thereon set out their Distances at pleasure; this middle Line will terminate at the Circle *g*, under which must stand the Newel, and the Extreams of the Plans of the Ballusters on the inward Side will be *p q*, *r s*, *t v*, *u w*, *x y*, *z*, at which last the twisted part terminates, and from thence to the Eye is horizontal.

To find the Lengths of the Ballusters and Newels.

(1) DRAW a Right-line at pleasure, as *z p*, Fig. II. Plate CCCCXL. and therein assume a point, as at *l*. (2) In Fig. VI. observe where the Scroll begins, as at *l*, against which suppose a point in the Line *s p*; take the Distances from this point to *r* and to *s*, and set them from the point *l*, in Fig. II. to *r* and *s*; also make the Distances of *r q*, *q p*, in Fig. II. equal to *r q*, *q p*, in Fig. VI. as likewise the Distances *s t*, *t v*, *v u*, *u w*, *w x*, *x y*, *z*, in Fig. II. equal to the Distances *s t*, *t v*, *v u*, *u w*, *w x*, *x y*, *z*, in Fig. VI.

TAKE from the Plan, Fig. VI. the Distance from *l* to *m*, and make *h n* in the Pitch-board equal thereto, and draw *n o* in the Pitch-board parallel to *i k*; make the Triangle *l h o*, Fig. II. equal to the Triangle *h n o* in the Pitch-board R, then will the Angle *&* *h p*, Fig. II. be the Angle of the Rail, and the Line *h o &* will be its Slope. Divide *h o* and *h z*, Fig. II. each into any Number of equal parts, and draw the intersecting Lines to generate the Curve *z o*; from the Points *r*, *q*, *p*, in Fig. II. draw Right-lines at Right-angles to the Line *z p*, and each equal to the Length of the fixed Ballusters, as *b*, *a*, and describe the Step S, below which set the Step T, whose Height is equal to *i k* of the Step-mould R. Draw Right-lines from the Points *t*, *v*, *u*, *w*, *x*, *y*, *z*, at Right-angles to *z p*, Fig. II. which continue up to the Curve, and down to the Steps, which are the true Lengths of the Ballusters *a*, *b*, *c*, *d*, *e*, *f*, in Fig. VI. The Length of the Newel is equal to the Length of the Balluster at *z*, because there the Twist ends, and are both on the same Level.

Note, The Plan of the first, or Curtal-step P, in Fig. VI. is formed in the same Manner as the Plan of the Rail; and what is here said with respect to the first two Steps of a Stair-case, the same is to be understood as if a whole Flight had been understood.

To square a Rail that ramps on a circular Base.

THE Plan Fig. VIII. Plate CCCCXL. is of a Stair-case, at whose landing is a Quadrant of a Circle; to make this familiar to the Understanding, the upper three Steps are represented at large in X, Fig. IX. with a Section of the Rail, with its Ramp and Kneel, which are described by the same Method as those of C, Fig. II. Plate CCCCXLI. In Fig. Y is the Plan of the Rail, from which trace a Raking-mould, as before taught in Fig. IV. that will be agreeable to the Angle made by the Raking-rail *m l*, and the Line *o k*. In this Operation there will be a considerable Thickness required on the Back of the Rail, as appears by Fig. III. The next Work is to square the Rail, as before taught, which being done, make *o p*, Fig. I. equal to *o c*, Fig. IX. and compleat the geometrical Square *c a o p*; make *p g*, Fig. I. equal to that part of *a p* in Fig. IX. as is contained between *p* and the upper Part of the Rail, and draw *g i*, Fig. I. parallel to *o p*. Make *a b*, Fig. I. equal to the Curve of the outer Quadrant *g h* in Y; and as *o p*, the Breadth of the upper Step, is equal to *d e* the Radius of the Arch *h g*, therefore make *a b* in Z equal to the Curve *h g*, and then the Point *b* in Z will represent the Point *b* in Fig. IX.

NOW, to find the Curve *b g* in Z, divide *b a* in Fig. IX. into any Number of parts, and divide *b a* in Z in the ſame Proportion, and then drawing equal Ordnates in each, you may deſcribe the Curve *b g* in Z; and as the lower raking part in Z is the ſame as that in X, therefore the Mould Z will bend about with the Rail, becauſe *a b* in Z is equal to the Girt of the Curve *b g* in Y, and becauſe the Height of the Curve *b g*, over its Ordnates, is equal to the Curve of the Ramp in Fig. IX. Make *p k*, Fig. III. equal to *p k* in X, alſo make *p e* equal to *p g* in Fig. I. and draw *e f* parallel to *o p k*; make *e a* equal to *g a* in Fig. I. and draw *a c* parallel to *o p*; make *a b* equal to *e f*, the inner Quadrant in Y. Divide *b a* in ſuch proportion, as before you divided *b a* in Fig. IX, and draw equal Ordnates, through which trace the Curve *b e*, which is the Curve of the inner Mould,

Note, The Heights *o c*, in Figures I. and III. are each equal to the Height *o c* in Fig. IX. Now if you bend both theſe Moulds round the Rail, they will form an exact ſquare Back, by drawing by their upper Edges Lines with a Pencil, and cutting away the ſuperfluous Wood.

THE Figure M exhibits a Method to have the Newel under the Twiſt the ſame length as the reſt, by which Means the Rail twiſts no farther, than the firſt Quarter, and therefore the remaining part may be cut out of a Plank the Thickneſs of the Rail without Twiſting, wherein *l f* is the Thickneſs of Wood wanted on the Back of the Rail.

Other Methods for ſquaring twiſted Rails.

THIS Maſter propoſes three other Methods to perform this Operation, but doth not heartily recommend them, as that, when they are done, they will not have that agreeable Turn in their twiſted part, as they would have by the Rule aforeſaid.

THAT of P, in Plate CCCCXLIII. is the raking Mould, taken from K in Plate CCCCXL. the Triangle Q in Plate CCCCXLIII. is the Pitch-board taken from I in Plate CCCCXL. which gives the Rake, or Reclination of the Rail.

IN R, Plate CCCCXLIII. is ſhewn, *How to ſquare a Rail without bending a Templet about the twiſted part*, and which is done by making the Back your Guide, as follows; deſcribe the bigneſs of the Stuff to be uſed, as the Parallelogram *a b h i*, which ſhews how much Wood will be wanted at bottom, ſuppoſing that S is the Side of the Rail; and in conſideration that the Grain of the Wood ſhould be agreeable to the falling of the Twiſt, therefore conſider how many Thickneſſes of Stuff will make the Body required, to cut the Twiſt out of, which, in this Example, are three, therefore (as in S) continue the Line *ab* to *c*; on *a*, with the Radius *a c*, deſcribe the Arch *d c*, which divide into 4 equal parts, as at 1, 2, 3, becauſe the Rail S muſt be always reckoned as one. This (ſaith this Maſter) by Inſpection ſhews how the Grain of the Wood is to be managed, as the Forms of the Pieces T, U, W, exhibit, which will be beſt, if cut ſo by the Pitch-board, before they are glued together.

IN X, Plate CCCCXLIII. is ſhewn, *How to ſquare the twiſted part*, making the bottom your Guide, whoſe Section ſhews how much Stuff is wanted on the back. In Y is ſhewn, *How to ſquare the twiſted part*, making a middle Line on the back your Guide, whoſe Section ſhews the Stuff wanting on the back, and at the bottom. That of Z may be cut out of a parallel Piece, of the Thickneſs of the intended Rail, which, when it is glued to the twiſted part, will want very little (if any) Amendment. Thus much for the Works of this moſt perplexed Maſter, who, not having been able to expreſs his own Meaning, has given me much Trouble to make his Rules practicable and eaſy to the young Student.

Plate

Plate CCCCXLIV. *Cylindrical Stairs, by* J. VREDEMAN.

ON the Left Side of this Plate is a Plan and Section of a Cylindrical Stair-case, whose Newel is very small, as generally practised in Stair-cases to Church Steeples, and is given here as an Example of that Kind. The Figure on the Right Side is a perspective Section of such a Stair-case, whose Top or upper Part being viewed, under a much lesser Angle than its Base, doth therefore appear diminished in such a Manner, that if its Sides were continued, they would meet in a Point; and as the Heights of every Step from the Bottom is seen under lesser and lesser Angles, therefore their Heights do appear less and less, as they are higher and higher, which in Part VII. of *Perspective* will be fully demonstrated.

Plate CCCCXLV. *A Plan and Section of a Stair-case, by* I. JONES.

THIS Stair-case is now standing in a House adjoining to the Cloysters of *Westminster-abbey*, wherein the Right Hon. the Earl of *Ashburnham* lately dwelt, and which Stair-case his Lordship did inform me was built by Mr. *Webb*, a Disciple of *Inigo Jones*, not by *Inigo Jones* himself, tho' perhaps the Design might have been made by *Inigo Jones*, and executed by Mr. *Webb*. In its upper Part is a spheroidical Dome, supported by small Columns on Pedestals, between which are Ballusters, and, if I mistake not, a Gallery within them. The Whole is not large, and of the *Ionick* Order, and which would have a better Effect than it now hath, was it of greater Dimensions; and, indeed, if the upper Order of Columns, that sustain the Dome, had been made of the *Corinthian* Order, it would have been more masterly, and better Architecture than it now is, where the *Ionick* on the *Ionick* seems to be absurd.

Plate CCCCXLVI. *The Formation of twisted Rails, by Mr.* W. HALFPENNY.

PROPOSITION I. Figures N *and* K.

To find the Curvature, or Raking-arch of a Hand-rail to a cylindrical Stair-case, whose Plan is a Circle, as Fig. N, *or an Ellipsis, as Fig.* O.

FIRST, make Fig. K, representing the Height and Tread of the Steps, which last must be adjusted from the Plan N, wherein the Number of Steps about the Cylinder being before determined, (suppose twelve) the Distances *n o*, *o p*, &c. will be the Length of the Tread of each Step. The Height of each Step must be such, as that their under Parts may admit of a free Head-way, and therefore should not be less than 7 Inches rise; for 12 times 7 is but 7 Feet; nor should their Height be much greater, lest they are found too laborious in ascending. Take the Back or Rake of a Step, as *c f*, and on *n*, in Fig. N, describe the Arch *m*; also on *o*, with the Height of one Step, as *a c*, describe the Arch *l*, and from the Point of their Intersection to the Point *n* trace a Curve; on the Section *l*, with the Radius *n m*, describe the Arch *i*; and on *p*, with the Height of two Steps, describe the Section *k*; also on the Section *k*, with the Radius *n m*, describe the Arch *h*; and on *q*, with the Height of three Steps, make the Intersection *g h*. Proceed in like Manner with the others, and thro' their Intersections, with a thin Rule, trace the Curve required. Fig. O is the Plan of an elliptical Stair-case, whose Rail hath its Curve found in the very same Manner as its Lines do express.

PRO-

PROPOSITION II. Figure I.

To prepare their Rails, and work their Twists.

MAKE the Circles 1, 2, 4 equal to *t u w n*, Fig. N, and consider how many Pieces you'll give to the Rail, which, in this Example, we suppose to be six; divide the Semicircle 1 13 4 into 6 equal parts, at the Points 8, 9, 13, 15, *x*, and from thence draw Right-lines to the Center 3; on the Points 8, 9, 13, 15, *x*, 4, raise Perpendiculars, as 8, 11, equal to (*c a* in Figure K) the Height of one Step, also 9 *z* equal to the Height of two Steps, 13 *u* to the Height of three Steps, 15 *p* to the Height of four Steps, *w k* to the Height of five Steps, and 4 *e* to the Height of six Steps; at the Ends of all these Perpendiculars erect other perpendicular Lines, as 11 7, *z x*, *u q*, *p l*, *k g*, and *e b*, each equal to 1 3, the Radius of the Cylinder; also on these last Perpendiculars erect others, as *b a*, *f g*, *l m*, *q r*, *x v*, 15 7, *&c.* making each equal to the Height of one Step, and then compleat the Triangles *a b e*, *f g k*, *m l p*, &c. also make 3 6 equal to the Height of one Step, and compleat the Triangle 1 3 6.

SET off the Width of the Rail from 1 to 2, from 11 to 12, from *z* to *y*, from *u* to *t*, from *p* to *o*, from *k* to *h*, and from *e* to *d*; from the Points 2, 10, 16, *s*, *n*, *y*, *c* let fall Perpendiculars on the Lines 1 6, 11 15, *z v*, *u r*, *p m*, *k f*, and *e a*, as 2 5, 10 12, 16 *y*, *s t*, *n o*, *y h*, and *d c*; then will the Triangles *d c e*, *h i k*, *o n p*, &c. represent the parts, that must be taken off from the back, at the lower End, to form the Twist of the Rail.

TO apply these Lines to Practice, take the Piece of Timber, of which you design to make the first length, which suppose to be Figure M; plane one Side strait, and cut it to its Bevels *a c*, *f l*, answering to 4 3 *x* and 4 *x* 3, Figure I. and then both its Ends being cut to the raking Joint of the Rail, proceed as follows; take that part of the raking Arch in Figure N, which is equal to the first length of the Rail, as *n m*, and lay it on the upper Side of Figure M, from *b* to *k*, and describe the Arch *b k*; make *k i* equal to 11 12 in Fig. I. from the Point *i* draw *i g*, at Right-angles to *i k*, and equal to 16 *y* in Fig. I. and draw the Line *g k*, which is equal to 1 2 in Fig. I. and represents the back of the Rail, when worked. This being done, represent the lower End of the Rail *g k o m* at Right-angles to *k g*, also the upper End *a b e d*, at Right-angles to *a b*, and embost out the inward Arch *a i* square from the upper side *c d a f*, as *i g*; take a thin Lath, and bend it close to the Side from *a* to *g*, and by its Edge describe a Line; then will the Lines *a g* and *b k* be your Guide to back the Rail, and which being done, turn the Piece upside down, and with the Mould describe an Arch from *d* to *m* equal to *b k*, and embost out the Side to the Lines *b k* and *d m*, and then will one Side and the Back be squared, which is the greatest Difficulty in the forming of a twisted Rail, and which is a Gage for the other two Sides.

IT is to be observed in Fig. I. that if the Triangles 1 3 6, 11 7 15, *z w v*, *u q r*, *p l m*, &c. and the Lines whereon they stand, as 3 6, 1 81, 12 *z*, 13 *u*, 15 *p*, *w k*, and 4 *e* were to be raised up perpendicularly over the Center 3, then the Lines 3 6, 7 15, *x v*, *q r*, *l m*, *g f* and *b a* will generate one Right-line, and whose Base will be the Point 3, and their Heights, being taken together, will be equal to seven Risings, or Steps; but as in the working of a Hand-rail there need be but one of these Triangles made to work from, they being all equal, and have the same Effect in working, therefore it's to be noted, that the representing of so many is for no other Purpose, but to make the Whole more intelligible to the young Student's Understanding.

TO perform the like Operation in an elliptical, or oval Stair-case, there's no other Difference, than the following, *that is to say*, whereas, in Fig. I. the Bases of the seven right-angled Triangles, as *b e*, *g k*, *l p*, *q u*, *x z*, 7 11, and 1 3 are all equal to the Radius of the Cylinder, as 1 3, or 3 4, &c. so here the Bases of these right-angled Triangles in Fig. L, as *b d*, *g k*, and *m p*, must each

each equal to the Lines 13 24, 10 29, and 6 3, becauſe the Point 6 is the Center of the Arch 2 28, as alſo is the Point 3 the Center of the Arch 7 11; and the Baſes *q u*, *w*, 14 17, of the three leſſer right-angled Triangles, muſt each be equal to the Radius of the leſſer Arch at the End of the Oval; the other Particulars being in every Reſpect the ſame, 'tis evident, that the whole Difference conſiſts in the two Triangles only, and which, being applied to its proper Curve, will form the two different Twiſts in the Rail, as required. Now from hence 'tis plain, that as many different Arches as are in the Baſe of a Rail, ſo many different Twiſts, and as many different Triangles will be made, becauſe it is by thoſe Triangles, that the Twiſts are found.

PROPOSITION III. Fig. D.

To form the Curvature or Mould of a Hand-rail that ſtands on two Steps.

(1) LET the dotted Lines *k*, *g*, *l*, *e*, repreſent the Breadths of three Steps, and let *k i*, *g h*, *l*, *d c b a*, repreſent the Plan of a Rail, whoſe curved part ſtands over the lower two. It is alſo ſuppoſed that the Curve *g l b* is one 4th part of an Ellipſis, and the Curve *b c* one 4th part of a Circle. The Outſide of the Newel *c* is fixed from the Line *k f*, at the Diſtance of a Step's Breadth, and which being divided into 3 equal parts, gives *b a* equal to one 3d for the Newel's Diameter. Make *a c* and *b d* each equal to *b a*, and draw *d c*, the Diameter of the Newel. If *g f*, whoſe Length is equal to 1 Step and two 3ds, be conſidered as one half of the longeſt Diameter of an Ellipſis, and *f b* as one half of its ſhorteſt Diameter, we may deſcribe the Curve *g l b*, and on the Point *d*, with the Radius *d b*, deſcribe the Arch *b c*. Aſſign *k i* for the Thickneſs of the Rail, and draw the Line *i h* parallel to the Line *k g*, and the Curve *h d* concentrick to the Curve *g l b*; and thus is the Plan completed.

(2) DRAW *k l*, in Fig. E, equal to *k g* in Fig. D, to repreſent the Tread of the Steps, as before, by dotted Lines. Divide that part of the Plan of the Rail, which belongs to each Step, into any Number of equal parts, as *a f*, into 5, and *f k* into 4.

ON a Piece of waſte Paper make a Parallelogram, as *b c a e*, Fig. H, making *b a*, *c e*, each equal to the Riſe of a Step, and *a e*, *b c*, to the Tread of a Step; alſo continue *e c* to *d*, making *c d* equal to *e c*; alſo continue *c b* out at Pleaſure. Make *c t* equal to the Curve *f a* in Fig. E, and divide *t c* into 5 equal parts at the Points *u*, *l*, *k*, *i*, from whence draw Right-lines parallel to *d c*, as *s u*, *z l*, *o k*, and *p i*; draw alſo the Lines *t d* and *b d*, and the Triangle *t d c* is the Bracket of the firſt Step, according to the Curve of the Rail. As *t c* is the Length of the Ground to the firſt Step, ſo is *t d* the Length of its Rail. Make *c b*, Fig. H, equal to the Curve *k f*, Fig. E; and as this Curve is divided into 4 equal parts, therefore divide the Line *c b*, Fig H, into 4 equal parts, at the Points *h*, *g*, *f*, and from thence draw Right-lines parallel to *e c*. The Line *c b* is the Ground-line of the ſecond Step, and *d b* the Length of its Rail.

(3) IN Fig. H, with the Radius *t s*, on the Point *a*, in Fig. E, deſcribe the Arch *m*; with the Radius *s u*, Fig. H, on *b*, Fig. E, interſect in *m*; on *m*, with the Radius *a m*, deſcribe the Arch *n*; and on *c*, with the Radius *z i*, Fig. H, interſect in *n*: In the like Manner on *n*, with the Radius *n m*, deſcribe the Arch *o*; and on *d*, with the Radius *o k*, Fig. H, interſect in *o*; and ſo in like Manner find the other Points, *p*, *q*, *z*, *s*, *t*, *u*, *w*, wherein ſtick Nails, &c. to which bend a thin Lath, ſo as to touch every of them, and by its Side deſcribe the Curve required.

To ſquare this Rail, Fig. A.

DESCRIBE the Curve *f e a* equal to the Curve *l k a*, Fig. E, and expreſs the Centers of the different Arches, as the Points *h* and *g*, from whence draw dotted Lines to the Places where you deſign to join the Rail, as from *g* to *b*,

and *c*, and from *b* to *e* and *d*; and becaufe the firft Step is to be joined in 3 equal Pieces, you muft take one 3d of the Rifing or Height of the Step, and fet it from *b* to *i* at Right Angles to *b g*, and draw the Line *m i* parallel and equal to *g b*. Draw *m n* at Right-angles to *m i*, to rife fo much as the Rail rakes over, which is one 3d of the Height (or Rifing) of the Step, becaufe that part of the Rail is one 3d of the Length on the firft Step, and draw the Line *n i*, then will *n m i* be the firft Triangle. From the Point *c* draw the Line *c q*, at Right-angle to *c g*, and equal to two 3ds of the Height of one Step, alfo draw the Line *q z* equal and parallel to *c g*; on *q z* draw *z s*, at Right-angles to *q z*, and equal to the Height of one 3d of one Step, and then, drawing the Line *s q*, the fecond Triangle is compleated. On the Point *d* erect the Line *d t*, at Right-angles to *d b*, and equal to the Height of one Step; draw *t w* equal and parallel to *d b*, and, on *w*, erect *x w* at Right-angle, and equal to the Height of one Step, and draw the Line *x t*, which will compleat the third Triangle. Make *i k*, *q o* and *t v* each equal to the Width of the Rail, and, from the Points *k*, *o*, *v*, let fall Perpendiculars on the Lines *o i*, *s q* and *x t*, then will thofe fmall Triangles reprefent the parts, that muft be taken off from the lower End of each Piece, to bring the Rail to its Twift.

PROPOSITION IV. Figures B, F, C, G.

To find the Curvature of a Hand-rail, whofe Bafe ftands on two Steps, as before, but hath a quicker Curvature.

LET Fig. B reprefent the Plan of a Rail, wherein *e a* is equal to the Height of a Step, which bifect in *c*; compleat the geometrical Square *c a d b*, and draw *e d*, which bifect alfo for the Center of the Newel; on the Center *d* defcribe the Arch *f c b*; continue *a b* to *g*, making *b g* equal to fix 7ths of the Width of a Step, and make *h g* equal to one Step and two 3ds: This being done, defcribe one 4th part of an Ellipfis, as the Curve *h b*, and thus is the Plan compleated. The Figure F reprefents the Out-line of the Plan, and raking Curve of the Rail, which Curve is thus found; divide the Curve, that ftands on the lower Step from g to *a*, into fix equal parts, as at the Points *g*, *f*, *e*, *d*, *c*, *n*; alfo divide the other part of the Curve *l g* into 4 equal parts, at the Points *k*, *i*, *h*. In Fig. G, make the Parallelogram *b c a e* equal to the Height and Tread of a Step; continue *c b* to *q*, making *q c* equal to the length of the Curve *g a* in Fig F, and divide *c q* into fix equal parts at the Points *p*, *o*, *b*, *k*, *i*; make *c d*, in Fig. G, equal to *c e*, and draw *d q*, alfo, from the Points *p*, *o*, *b*, *k*, *i*, draw Right-lines parallel to *d c*, cutting *d g* in *s*, *t*, *v*, *u*. Now, to find the raking Curve *x w q a*, Fig. F, on *a*, with the Radius *q v*, Fig. G, defcribe the Arch *b*, and on *n*, with the Radius *v p*, Fig. G, interfect in *b*; on *b*, with the Radius *a b*, defcribe the Arch *o*, and on *c*, with the Radius *u o*, Fig. G, interfect in *o*. Proceed on in like manner to find the other Points *p*, *q*, *r*, *s*, *t*, *v*, *u*, *w*, *x*, (as before in Figures H and E) through which, with a thin Rule, trace (or draw) the raking Curve *x q a* required. The part of the Curve *g a*, Figure F, is equal to the Line *q c*, in Figure G; and the Line *q d*, Fig. G, and the part of the Curve *s r q p o b a*, Fig. E, are alfo equal to each other. In Figure C, the Triangles *c l k*, *t s e*, and *g u v* reprefent the fuperfluous Stuff, that muft be taken away from the lower End of each Piece, to make the Twift required.

Plate CCCCXLVII. *The Curvatures of twifted Rails demonftrated.*

IF we confider, that the Area of the Outfide of a circular, or elliptical Cylinder is nothing more, than a right-angled Parallelogram, whofe Height is equal to the Height of the Cylinder, and Breadth to the Cylinder's Circumference, bent about the Cylinder, 'tis very eafy to underftand, that if on fuch a Parallelogram we defcribe the Rifes and Treaders of a ftraight Stair-cafe, with its

its Rail, *&c.* in one continued Flight, or otherwife, if required, with half Paces, Ramps, Rails, *&c.* and bend the fame about the Convexity of the Cylinder, then will the Curvature, made by the ftraight Rail fo bent, be the twifted Rail required. Hence 'tis plain, that a twifted Rail about a Cylinder is nothing more, than a Right-line placed at an Angle equal to the Afcent of the Steps, and bent about the Cylinder, which will always make the fame Angle with the Horizon.

DEMONSTRATION.

LET the Circle *c b a*, Fig. E, reprefent the Plan of a circular Newel, or of a circular Cylinder, whofe Altitude is *t a:* (1) Divide the Semicircle *c b a* into any Number of equal parts, that will be fpacious enough for the fmall Ends of the Steps, (fuppofe fix) as at the Points *h, g, b, f, e,* and draw the central Lines *h d, g d, b d, f d,* and *e d*; alfo, from the Points *h, g, f, e,* draw the Lines *h m, g l, f k,* and *e i,* which continue out at pleafure. (2) Continue out the Diameter *a c* at pleafure; draw *c n* parallel to *h m,* and equal to the Height of a Step; let *y n* be the length of a Treader, and *y z* the Height of a Rifer. In the fame Proportion compleat all the other Steps, (as in the Figure) and continue the Tread of every Step, until they meet the Lines *m h, l g, d b, k f,* and *i e* continued, and the Line *a t* in the Points *o, p, q, r, s, t,* thro' which trace the fectional Line, or Curve; make *o x* equal to the Ordnate *m h,* alfo *p w* equal to the Ordnate *l g,* and *q u* equal to the Ordnate *d b,* and, through the Points *u, w, x, n,* trace the Curve *n u.* Now, fince that the Points *o, p, q, r, s, t* are of the fame Altitude above the Bafe *c a,* as the feveral Treaders *y n,* 1 *z,* 3 2, 5 4, 7 6, 9 8, and 10; and as the Lines *o x, p w* and *q u* are equal to the Ordnates *m h, l g* and *d b.* therefore the Curve *n x w u* is one 4th part of the Curve, that will encompafs the Cylinder in one Revolution; for if the Lines *c n, o m, p l,* and *q d* were to be raifed perpendicularly over the Line *c a,* and the Lines *o x, wp,* and *u q* were to be fix'd at Right-angles to them, then their Points *n, x, w, u* would be perpendicular over the Points *c, h, g, b* in the Circumference, and equal in Altitude to the Treaders *n, z,* 2, 4, and confequently the Curve paffing through the Extreams *n, x, w, u,* is a quarter part of the Curve required. *Q. E. D.*

THE Figure F is a Plan of an elliptical Newel, whofe Section and quarter part of its curved Rail is found in the very fame Manner as the aforefaid, which the Lines exprefs.

NOW, from all that's delivered 'tis evident, that every fingle Flight of Stairs (whether ftraight or circular) may be confidered as a right-angled Triangle, as BCA, whofe Bafe, CA, is equal to the Tread of the feveral Steps, its Perpendicular B C to the Heights of the feveral Steps, and BC, its Hypothenufe, to their String; and therefore, if we divide B C and C A each into fuch Number of parts, as we fhall affign for the Number of Steps, aud from thofe Divifions draw Lines parallel to BC and C A, their Interfections will determine each Step in its Rife and Tread, as required.

PLATE CCCCXLVIII. is a perfpective View of a cylindrical Stair-cafe, whofe Rail is continued through many Revolutions, and whofe Curve is no other, than that of Figure E (Plate CCCCXLVII.) continued.

Plates CCCCXLIX. CCCCL. CCCCLI. CCCCLII. CCCCLIII.
Divers Kinds of Pavements.

AT *Stunsfield,* near *Woodftock* in *Oxfordfhire,* fome few Years fince, was found underground a Pavement, fuppofed to have been made by the ancient *Romans,* of *Mofaick* Work, whofe Plan is reprefented by Plate CCCCXLIX.

THE feveral Devices expreffed in this Plan are all made with little Cubes, whofe Sides are faid to be lefs than an Inch, fet together in a ftrong Cement (the Knowledge of which, I believe, is known but to very few); the Cubes themfelves

themſelves are of divers Colours, and many of Glaſs Compoſition, and which, having their Surfaces placed truly level, and poliſhed, do make a moſt beautiful Appearance. The two Sides and End of the outer Margin *g g g* are enriched with ſmall Cubes, as the End *f*, and the Fret is the ſame all round, as the angular part above on the right-hand Side, which is compoſed of very ſmall white and black Cubes, as the little Squares in the Plan expreſs. The Parallelograms *d, d, d* have the ſame Interlacing as the Parallelogram *c*, and the inner Margin next within the Fret is interlaced all round, as at the right-hand Angle above.

In the Diſtribution of the other parts there are ſome Things very odd and remarkable, as *firſt*, the Manner of dividing them, and *laſtly*, their Enrichments. In the upper part we ſee a geometrical ſquare Margin, whoſe Sides are each adorned with Parallelograms, and Rhombuſes inſcribed, as *b b b, a*, which, in general, are enriched with the Fret, as that at *a*, and the ſeveral angular parts have the ſame Enrichments, as the Angle contained between *a* and *b* on the right Hand; the Spandrels *h, l* are enriched as their Oppoſites; the next inward Circle is enriched with Interlacings, as the Specimen expreſſes; and the inſcribed Square, and its parts, with its circular Spandrels, as in the Plan.

The remaining part, being a Parallelogram, is very oddly divided with reſpect to the Uniformity of the Whole; for, inſtead of placing the lower geometrical Square to the Extreams of the hither End, (as the other is to the Extreams of the upper End) here is a Parallelogram above and below it, which (had they been placed together in the Middle, and the geometrical Square brought down to the End) would have preſerv'd a beautiful Regularity of parts, which, I think, is now wanting.

As to the many Devices herein expreſſed, and their Alluſions, I refer to the *Antiquarian*, and therefore ſhall only add, that as herein is a great deal of good Invention, that may be helpful to the young Student, it was therefore that I inſerted this Plan.

Plate CCCCL.

In this Plate is repreſented a very great Variety of Pavements, as well of the moſt common and ordinary, as the moſt rich and expenſive Kinds: The Figures F, N repreſent a rough Kind of ſquare Pavement fitting for Roads, as that before the Privy-gardens at *Whitehall*; that of Z is of common Pebbles, as in the Streets of *London*; and that of *h* of irregular Purbeck, a flat Kind of Pavement of great Strength and Duration, beſt for Foot-ways, Pavements of Kitchens, Brewhouſes, &c. and when laid in ſquare Work, makes a handſome Pavement. The Figures *d* and *e* repreſent two Kinds of Pavements made with *Dutch* Clinkarts, that of *d* is called a *ſtraight-joint* Pavement, and that of *e* a *Herring-bone* Pavement. The Figures *f* and *g* are of paving Bricks, of which that of *f* is *Brick in Breadth*, and that of *g Brick on Edge*, which is much the ſtrongeſt of the two; theſe two Kinds of Pavements are named as thoſe of *d e*. The Figure *p* is another Kind of Brick Pavement, that is very handſome, when the ſquare Spots (which are nothing but half Bricks laid in Breadth) are in their Colour, a good Oppoſite to the Stretchers that encloſe them. The Figures 2, *x*, *y* may be made, either of ſquare paving Tyles, or of Stone, or of Stone and Marble, or of Marble only; wherein 'tis to be obſerved, that as the Angles of every two Squares (in Fig. 2) come againſt the Side of a Square, that Kind of Pavement is therefore much ſtronger, than thoſe of *x y*, where the Angles of four Squares come together in one Point. The Figures 3 and *z* may be made either with paving Tyles made in hexangular Moulds, or with Stone, ſuch as *Portland*, *Newcaſtle*, &c. That of Fig. 3 is compoſed of *regular Hexagons*, whoſe Sides are equal; and that of Fig. *z* of oblong Hexagons, whoſe oppoſite Sides only are equal. The Figure 1 is compoſed of regular Octagons and geometrical Squares, or Dots; the Octagons are generally made of *Portland* Stone, and the Dots of black Marble; but as the *Portland*

Stone

Stone doth wear away much faſter than the Marble Squares, 'tis much better to lay the Whole with white and black Marble, or with *Portland*, &c. only, as Fig. 3. The Figures *t*, *v*, are compoſed of triangular parts; thoſe of *t* by the Interſections of the Diagonals, and ſhorteſt Diameters of Parallelograms; and thoſe of *v* by the Interſections of the Diagonals of geometrical Squares. The Fig. *w* is a Compoſition of geometrical Squares and Parallelograms, which in black and white Marble has a pretty Effect; as alſo have the Figures A, B and C. The Fig. E is an Invention of my own, and which being made with *White*, *Black* and *Dove* colour'd Marble, repreſents ſo many *Tetraedrons*, or Pyraments, with their vertical Angles, ſeemingly perpendicular to their Baſes; as alſo doth the Angles of the Cubes in Figures *q* and *r*, which in the Dusk of an Evening appears as ſo many ſolid Bodies not to be walked on. In Plate CCCCLI. I have expreſſed the Pavement of Cubes lying on their Angles more at large, as alſo another Kind, as Fig. B, where the Cubes are lying on their Baſes, and appear as Steps, which makes this Diſception very agreeable. Alſo, the other Figures of Plate CCCCL. are divers Varieties of beautiful Compartments and Bordures to Pavements, for Halls, Cabinets, *&c.* Fig. D, Plate CCCCLI. as alſo Figures A and B, Plate CCCCLII. and Figures A, B, C, D, E, F, G, are divers Pavements fit for Temples, *&c.* in Gardens, which I have given here for the Practice of young Students.

Plate CCCCLIV. *Proportional Lines, and the Similarity of Figures demonſtrated.*

FOR the better underſtanding of the preceding Plates, and for the Entertainment of the curious and induſtrious Student, I ſhall conclude the *Principles of Geometry* with the geometrical Proportions of Lines, the Similarity, Reduction, Transformation, Multiplication and Diviſion of geometrical Figures; and the geometrical Conſtruction of the twenty-four Letters of the Alphabet, by means of which the Magnitude and Proportions of large Capital Letters, for Inſcriptions, Motto's, *&c.* againſt Buildings of conſiderable Heights, are very exactly and eaſily determined.

I. *Of proportional Lines.*

PROBLEM I. Fig. A.

Between two Lines given to find a mean Proportion.

LET the Lines *a b* and *c d* be two given Lines, which together are equal to *k l*.

PRACTICE. Make *i e* equal to *k l*, which biſect in *f*, on which, with the Radius *i f*, deſcribe the Semicircle *i h e*; make *i g* equal to *a b*, and erect the Perpendicular *g h*, cutting the Semicircle in *h*, then is *g h* the mean Proportion required; for as *e g* is to *g h*, ſo is *g h* to *g i*.

COROLLARY. Hence a Right-line drawn in a Circle, from any Point of the Diameter perpendicularly, and continued to the Circumference, is a mean Proportion betwixt the two Segments of the Diameter.

PROBLEM II. Fig. B.

To cut a given finite Line in extream and mean Proportion.

LET *a b* be the Line that is to be cut, ſo that the Rectangle of the whole Line *a b*, and one of the parts *e b* (which is the Parallelogram *g h a b*) may be equal to the Square (*d f a e*) of the other.

PRACTICE. Erect the Perpendicular *a d*, which continue towards *c*; make *a c* equal to half *a b*; upon the Point *c*, with the Radius *c b*, deſcribe the Arch *b d*; upon the Point A, with the Radius *a d*, deſcribe the Arch *de*, which will cut *a b* in *e* in the Proportion required; for if you complete the Parallelo-

rallelogram *a g h b,* of the whole *a b,* and part *b e,* it will be equal to the Square *d f a e.* For if you complete the Parallelogram *a d i b,* and draw the Diagonal *a i,* it will interfect the Lines *f e* and *g h* in the fame Point, and divide the Parallelogram into two equal Triangles, which are *i a b* and *d a i.* The Parallelograms *g e* and *f h* are alfo each divided into two equal Triangles by the Diagonal, in the fame Manner. Now, feeing that the Triangles of thefe two Parallelograms are refpectively equal, and as the Triangles *d a i* and *i a b* are both equal, therefore the Parallelogram *g f* is equal to the geometrical Square *e h,* and confequently the two Parallelograms *e g* and *g f,* which together make the geometrical Square *d f a e,* are equal to the Parallelogram *g e,* and Square *e h* taken together, becaufe the Parallelogram *g e* is common to them both, and that the Parallelogram *g f* is equal to the Square *e h. Q. E. D*

PROBLEM III. Fig. C.

Two Lines being given (as a b and c d) to find out a third in Proportion to them.

PRACTICE. Draw two Right-lines, forming any Angle, at pleafure, as *h e* and *k e* ; make *f e* equal to *c d,* and *i e* equal to *a b,* and draw *i f* ; make *k i* equal to *f e,* and draw *k g* parallel to *i f,* then is the Line *f g* the third Proportional ; for, as *e i* is to *i k,* fo is *e f* to *f g, which was to be done.*

PROBLEM IV. Fig. D.

Three Right-lines being given, (as a b c) to find out a fourth Proportional, f h.

PRACTICE. Draw a right-lined Angle at pleafure, as in the preceding Problem ; make *d e* equal to the Line *c,* alfo *d f* equal to the Line *b,* and *e g* equal to the Line *a* ; draw *e f,* and *g h* parallel to *e f,* then is *h f* the fourth proportional Line required ; for as *d e* is to *e g,* fo is *d f* to *f h, which was to be done.*

PROBLEM V. Fig. E.

To divide a Right-line given (as a b) into two parts, in Proportion one to the other, according to two given Lines (as d, c).

DRAW a Right-line, at pleafure, from one End of the given Line, as *a e,* making any Angle ; make *a f* equal to the Line *c,* and *f e* equal to the Line *d* ; draw *e b,* alfo *f g* parallel to *e b,* dividing the given Line *a b* in *g* ; then, as *a f* is to *f e,* fo is *a g* to *g b, which was to be done.*

PROBLEM VI. Fig. F.

The greater Segment of a Line divided by extream and mean Proportion being given, to find the whole Line.

LET *b e* be the greater Segment given.

CONTINUE *b a* towards *c* at pleafure ; make *b d* perpendicular to *b a,* and equal to half *b a,* and draw the Line *d a* ; make *d f* equal to *d b,* and *a c* equal to *a f,* then is *b c* the Length of the whole Line, as required.

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PROBLEM VII. Fig. G.

The Sum of the Extreams, and the mean Proportional being given, to find the Means.

LET *b a* be the Sum of the Extreams, or two given Magnitudes connected without any Diftinction, and *g h* the mean Proportional, by means of which the Point *f*, where the Extreams join, is to be diftinguifhed.

PRACTICE. Bifect the Line *b a*, and defcribe the Semicircle *b e a*; erect the Perpendicular *b k* equal to the mean Proportional *g h*, and draw *k i* parallel to *b a*, which will cut the Semicircle in *e*; from *e* draw *e f* parallel to *k b*, then will the Point *f* be the Point required, and *e f* will be a mean Proportional between *b f* and *f a*.

PROBLEM VIII. Fig. H.

To divide a Right-line in any Ratio propofed.

Suppofe *a b* to be divided according to the Ratio's of the Lines *a* 1, *b* 2, *c* 3, *d* 4.

PRACTICE. From the Point *a* draw the Line *a m* at pleafure, without regard to the Quantity of the Angle *m a b*; make *a h* equal to the Ratio *a* 1, make *h i* equal to the Ratio *b* 2, make *i* 3 equal to *c* 3, and 3 *m* equal to *d* 4; draw the Line *m b*, alfo the Lines 3 *n*, *i o*, and *k p* parallel to *m b*, cutting the Line *a b* in the Points *p*, *o*, *n*, and divide it according to the Ratio demanded.

PROBLEM IX. Fig. I,

To find a mean Proportional between two given Right-lines.

SUPPOSE the Lines *g h* and *n m* be the two given Lines, between which a mean Proportional is to be found.

PRACTICE. Draw the Right-line *f e* at pleafure; make *f b* equal to *n m*, and *b e* equal to *g h*; bifect *f e* in *d*; on *d*, with the Radius *d e*, defcribe the Semicircle *f o e*; on *b*, raife the Perpendicular *b o*, which is the mean Proportional required.

P. *Pray, What is to be underftood by a mean proportional Line?*

M. A mean proportional Line, as *o b* is a Line, which being multiplied into itfelf, produces a geometrical Square, whofe Area is equal to the Area of a Parallelogram, of Length and Breadth, equal to the two given Extreams *f b* and *b e*.

PROBLEM X. Fig. K.

A Right-line being given, to cut off a Part, that fhall be a mean Proportional between what remains, and another given Right-line.

SUPPOSE *a b* be the Line, of which a part is to be cut off, that fhall be a mean Proportional between what remains, and *d e* the Line propofed.

PRACTICE. Draw the Line *l f* at pleafure; make *l i* equal to *d e*, and *i f* equal to *a b*; defcribe the Semicircle *l m f*; from *i*, erect the Perpendicular *i m*; bifect *l i* in *k*; draw *m k*, and on *k*, with the Radius *k m*, defcribe the Arch *m g*, cutting *l f* in *g*; then is *i g* equal to *a c*, the part demanded.

PRO-

PROBLEM XI. Fig. L.

Two Right-lines being given, to cut each into two parts, ſo as that the four Segments may be proportional.

SUPPOSE *b a* and *d e* be the two given Right-lines.

PRACTICE. Draw *g n* and *o n*; erect the Perpendicular *n e*, both of Length at pleaſure; make *n g* equal to *b a*, and *n e* equal to *d c*, and draw the Hypothenuſe *e g*; deſcribe the Semicircle *g h n*; from the Point *h*, draw the Line *h i*, parallel to *e n*, alſo *h f* parallel to *i n*; then *g n* being cut in *i*, and *e n* in *f*, the part *g i* will be to *i h*, as *i h* is to *h f*, and *i h* is to *h f*, as *h f* is to *f e*, *which was to be done.*

PROBLEM XII. Fig. M.

To find out Right-lines, having ſuch Proportion one to the other, as two geometrical Squares given.

SUPPOSE the Lines *a* and *b* are the Sides of two Squares. Make the Right-angle *e d c* at pleaſure; make *d c* equal to the Line *a*, and *d e* equal to the Line *b*; draw the Hypothenuſe *e c*, and let fall the dotted Perpendicular *d* thereon, which will divide *e c* into two parts, the leſſer equal to 9, the greater to 16, and which are in proportion to one another, as the Square of *a* 20, is to the Square of *b* 15. For as 225, the Square of the Line *b* 15, is to 400, the Square of the Line *a* 20, ſo is 9, the leſſer Segment of *e c*, to 16, the greater Segment.

II. *Of the Similarity of Figures.*

SIMILAR Figures are ſuch which are equi-angled, or have the Angles of the one ſeverally equal to the Angles of the other; having alſo the Sides about thoſe equal Angles proportional, as in the two Triangles N and T, wherein the Angles *p* and *b* are common; that is, the Angle *p* is common to the whole Triangle N, and to the ſmall Triangle *o p q*; and as the Line *o q* is parallel to the Hypothenuſe of the Triangle N, therefore the Angles of the ſmall Triangle *o p q*, are equal to the Angles of the Triangle N, and conſequently its Sides are proportional alſo. If the Triangle *m l n* be made equal to the Triangle *o p q*, then the Triangle *m l n* will be ſimilar to the Triangle N; and ſo in like Manner, the ſame is to be underſtood of the Triangle V, equal to the Triangle *a b c*, to be ſimilar to the Triangle T, and the Triangle *i k h* to the Triangle S. As the Angles of all geometrical Squares are Right-angles, and all the Sides of every Square are equal, therefore all geometrical Squares are ſimilar to each other; ſo in Fig. R, the Square *t s w v* is ſimilar to the Square *q p s r*, and all equilateral Triangles, as V and T are ſimilar for the ſame Reaſon alſo If oblique Triangles, as X and Y, have their reſpective Angles equal, they will be ſimilar to one another, and their Sides will be proportionable alſo. The ſame is alſo to be underſtood of *Trapezia's*, *Pentagons*, *&c.* which are ſo made as followeth.

PROBLEM I. Figures Q. W.

A Right-line being given (as m a) to make a Trapezia (i e m a) ſimilar to (x y p g, Fig. Q.*) a Trapezia given.*

PRACTICE. Draw the Diagonal *x g*; make the Angle *i m a* equal to the Angle *x p g*; make the Angle *m a i* equal to the Angle *p g x*, then will the Triangle *i m a* be ſimilar to the Triangle *x g p*. In the ſame Manner, make the Triangle *i e a* ſimilar to the Triangle *x y g*; that is, make the Angle

gle $h i f$ equal to the Angle $w x s$, and the Angle $c a b$ equal to the Angle $s g q$; then the Trapezia $i e m a$, made on the given Line $m a$, will be fimilar to the Trapezia $x y p g$, as required.

PROBLEM II. Figures O. P.

A Right-line being given (as 1 *z*, Fig. P.) *to defcribe an irregular Pentagon (as* 1 *y x w z) fimilar to an irregular Pentagon* (*as* Fig. O.)

PRACTICE. (1) Extend $e d$ both Ways towards l and f; on the Points e and d, with any Opening, defcribe the Arches $l h$ and $f i$; and from the Points e and d draw Lines through the Angles c, b, a, cutting the Arch $l h$ in the Points $n m$, and the Arch $f i$ in the Points $g i$. (2) Continue 1 z at pleafure towards 2 and v; on the Points 1 and z, with the Radius $d l$, defcribe the Arches 2 $q t$ and $v r o$; make $v r$ and $r s$ equal to $f g$ and $g i$, and draw the Lines r 1, s 1; alfo make 2 q and $q s$ equal to $l n$ and $n i$, and draw the Lines $q z$, $s z$; make 2 3 equal to $l m$, and draw the Line 3 z, interfecting the Line s 1 in x; make 3 t equal to $m b$, and draw $t z$, interfecting $t z$ in w; alfo make $s o$ equal to i 4, and draw o 1, interfecting $q z$ in y; laftly, draw 1 y, $y x$, $x w$ and $w z$, which will complete the irregular Pentagon, as required.

Plate CCCCLV. *The Reduction, Transformation, and Equality of geometrical Figures demonftrated.*

I. *Of the Reduction of geometrical Figures.*

BY Reduction of geometrical Figures, is meant the Manner of reducing or transforming any given Figure, as a Triangle, &c. into another Figure required, as a geometrical Square, &c. whofe Area fhall be equal to the Triangle, &c. given.

PROBLEM I. Fig. A.

To reduce a Triangle (as d c a) into another Trianrle (as b c a) having one Side (as c a) common to both.

SINCE that by the 37th Propofition of the firft Book of *Euclid*, Triangles *ftanding upon the fame Bafe, and between the fame Parallels, are equal the one to the other*; therefore from the Point d draw the Line $d f$, parallel to the Side $c a$, which is to be common to both Triangles; and in the Line $d f$ affign any Point, as at b, and complete the Triangle $c b a$, which having $c a$ for its Bafe, and being between the Parallels $d f$ and $c a$, is therefore equal to the Triangle $d c a$, as required.

PROBLEM II. Fig. B.

An Angle being given, as e b c, and from a Point, as e, in the Line b e, is drawn a Line by Chance of any Length, as e f, cutting off from the Angle e b c the Triangle g. Now 'tis required from c, to draw a Line to fome part of e f, as the Line c f, to enclofe a Triangle as h, equal to the Triangle g.

PRACTICE. Affign the Point c in the Side of the Angle $b c$; from the Point e draw the Line $e c$; and from the angular Point b draw the Line $b d$, parallel to $e c$, cutting the Line $e f$ in f; laftly, draw the Line $f c$, which will enclofe the Triangle h equal to the Triangle g, as required.

PROBLEM III. Fig. C.

To reduce any Triangle (as c a b) into a geometrical Square (as e d f c).

LET fall a Perpendicular (as *a b*) from an Angle on a Side; continue the Side (*b c*) equal to (*a g*) half the Perpendicular, from *c* to *o*; bisect *o b* in *h*; on *h* defcribe the Semicircle *o d b*; from *c* raife the Perpendicular *c d*, which is a mean Proportion between *o c* and *c b*; and the Side of a Square (*e d f c*) is equal to the given Triangle, as required.

PROBLEM IV. Fig. D.

A Triangle being given (as c b a) to make another Triangle e d a equal thereto, whofe Perpendicular e e is limited to the Length of the Line f g.

AT the Diftance of the Line *f g*, draw a Line parallel to *b a*, as the dotted Line *e*, cutting the Side *c a* in *e*; draw *e b*, alfo *c d* parallel to *e b*, cutting the Bafe *a b*, being continued in *d*; and draw *e d*, then is the Triangle *e d a* equal to the Triangle *c b a*; for as the Triangles *c e d*, and *d b c*, are between the Parallels *c d* and *e b*, and have the Line *c d*, as a Bafe common to them both, they are therefore equal; and as the Triangle *c b d* is common to them both, therefore the Triangle *b d b* taken in, is equal to the Triangle *c b e* excluded, and confequently the Triangle *e d a*, is equal to the Triangle *c b a*, as required. Fig. W. is a fecond Example given for further Practice.

PROBLEM V. Fig. E.

To reduce any Triangle (as c i g) into a Parallelogram (as f a i g).

FROM any Angle (as *c*) let fall a Perpendicular (as *c b*) on the oppofite Side, which bifect in *e*, through which draw *f a* parallel to *i g*; alfo draw *i f* and *g a* parallel to *c b*; then will the Parallelogram *f a i g* be equal to the Triangle *c i g*, becaufe the Triangle *f d i* is equal to the Triangle *c d e*, and the Triangle *b a g* to the Triangle *c e b*.

PROBLEM VI. Fig. F.

To reduce a Triangle (as b h k) into a Rhombus (as d c h i).

THRO' the Angle *b* draw the Right-line *a c* parallel to the Bafe *h k*; bifect the Bafe *h k* in *g*; on the Points *h* and *g*, defcribe the Arches *h f*, *g f*, and through *f* draw the Line *h d*, meeting the Line *a e* in *l*; find a mean proportional Line between *h l* and *h f*, which is equal to *h d*; make *h i* equal to *h d*; from *d* draw *d e* parallel to *h i*, and from *i* draw *i c* parallel to *h d*, then will the Rhombus *d c h i* be equal to the Triangle *b h k*, as required.

PROBLEM VII. Fig. G.

To make a Rhomboides (as g e f a) equal to a Triangle given, (as b c a) having two oppofite Angles, each equal to d, an Angle given.

THRO' the Point *b* draw the Line *i e* parallel to *c a*; make the Angle *c a e* equal to the Angle *d*, and draw *a e*, until it cut *i e* in *e*; bifect the Bafe of the Triangle *c a* in *f*, and draw *f g* parallel to *a e*; then will the Rhomboides *g e f a* be equal to the Triangle *b c a*; for, fuppofing a Line be drawn from *g* to *a*, it will divide the Rhomboides into two equal parts, and be alfo equal to half the Triangle *c b a*, becaufe it ftands on half its Bafe, and is of the fame perpendicular

lar Height; and, as the Triangle *g f a* is equal to *g a e*, therefore the Rhombus *g e f a* is equal to the Triangle *c b a*, as required.

PROBLEM VIII. Fig. H.

To reduce a Parallelogram (as d a h e) into a geometrical Square (as c b h f).

CONTINUE a Side, as *e h*, from *h* to *i*, making *h i* equal to *h d*; bisect *i e* in *g*; describe the Semicircle *i c b e*; continue *h d* to *c*; then is *h c* a mean Proportional, and the Side of a Square (*c b h f*) equal to the Parallelogram, as required.

PROBLEM IX. Fig. I.

To reduce a geometrical Square (as d c b a) into a Parallelogram, (as m l x b) whose Height is limited equal to the given Line e f.

CONTINUE *a b* to *x* at pleasure, and make *b l* equal to *e f*; make *d l* equal to *l a*, and draw *d l*, which bisect in *h*; on *h* erect the Perpendicular *h i*, cutting *x a* in *i*; on *i*, with the Radius *i a*, describe the Semicircle *l d x*; on *x* erect the Perpendicular *x m* equal to *b l*, and join *m l*, which completes the Parallelogram *m l x b*, equal to the Square *d c b a*, as required.

PROBLEM XII. Fig. K.

To reduce a geometrical Square (as c d b a) into a Parallelogram, (as f e a l) whose Length is limited equal to the given Line z x.

CONTINUE *b a* to *l*; make *a l* equal to *z x*; draw the Line *d l*, which bisect in *o*, whereon raise the Perpendicular *o k*, cutting *b l* in *k*, on which, with the Radius *k l*, describe the Semicircle *l d m*; make *a f* equal to *a m*, also *e l* equal and parallel to *a f*; draw *f e*, and the Parallelogram *f e a l* will be equal to the Square *x d b a*, as required.

PROBLEM XIII. Fig. L.

To reduce a given Parallelogram (as d c a b) into another Parallelogram (as f e b l) whose Breadth is limited, equal to x z.

CONTINUE *a b* towards *l*, at pleasure, also *a d* to *g*, making *d g* equal to *x z*; from *g*, through the Point *c*, draw the Line *d c l*, cutting the Line *a b l* in *l*, then will *b l* be the Length of the Parallelogram; make *b f* equal to *x z* the given Breadth, and then, making *l e* equal and parallel to *b f*, draw *f e*, which will compleat the Parallelogram *f e b l*, as required.

PROBLEM XIV. Fig. M.

To reduce a given Parallelogram (as c b d a) into another Parallelogram, (as h g f a) whose Length is limited, equal to e e.

CONTINUE *a d* towards *f*, at pleasure, and make *a f* equal to *e e*: Now say, As *e e*, the Length limited, is to *c d*, the given Breadth, so is *a d*, the given Length, to *h f*, the Breadth required.

OPERATION, Fig. O.

MAKE the Angle *o i p* at pleasure; make *i n* equal to *e e*, and having *c d* in your Compasses, set one Foot in *n*, the other will fall on *l*, and draw *l n*; make

i m

i m equal to *a d*, and from *m* draw *m k* parallel to *l n*, which will be equal to *h f*, the Breadth required.

PROBLEM XV. Fig. P.

To reduce a Rhombus (as c d b a*) into a geometrical Square (as* n l h e*).*

DRAW the Perpendicular *d e*, and extend it up towards *l*; make *e g* equal to *e d*; and make *e h* equal to *a b*; biſect *h g*, and deſcribe the Semicircle *h l g*, which cuts the Perpendicular *e d* in *l*, then is *l e* the Side of the Square required.

PROBLEM XVI. Fig. Q.

To make an equilateral Triangle (as i f g*) equal to a geometrical Square, whoſe Side is equal to* a a*).*

MAKE *f g* equal to twice *a a*; at the End *f* make the Angle *h f g* equal to 60 deg. draw *e e* parallel to *f c*, at the Diſtance of *a a*, which will cut *f h* in *h*; make *f b* equal to *f h*; find a mean Proportion between *f b* and *f c*, which is *f g*, and draw the Line *i g* parallel to *h b*; then is the equilateral Triangle *i f g* equal to a geometrical Square, whoſe Side is equal to *a a*, as required.

PROBLEM XVII. Fig. R.

To reduce a Trapezium given (as w a d o*) into a right-angled Parallelogram (as* n e k i*) or right-angled Triangle (as* h k i*).*

DRAW a Diagonal, as *w d*, and thro' the Points *a* and *o* draw Right-lines parallel to *w d*, of Length at pleaſure; alſo, thro' the Points *w* and *d*, draw Right-lines, at Right-angles to the former, which will compleat the Parallelogram *h g k i*, and circumſcribe the Trapezia *w a d o*, whoſe Area is equal to twice the Area of the Trapezia; for if, from the angular Points *a* and *o*, we ſuppoſe Perpendiculars to be drawn to the Line *w d*, then each oppoſite Triangle will be equal, and thoſe included within the Trapezium will be equal in Number and Area to thoſe without it, that makes good the Reſidue of the Parallelogram. Now, ſeeing that the Parallelogram *h g k i* is equal to twice the Trapezium *w a d o*, therefore biſect *h k* in *n*, and *g i* in *e*, and draw *n e*, which will divide the Parallelogram *h g k i* into two equal Parallelograms, *viz.* *h g n e* and *n e k i*, which are each equal to the Trapezia *w a d o*, as alſo is the right-angled Triangle *h k i*, which is half the Parallelogram *h g k i*.

PROBLEM XVIII. Fig. S.

To reduce a Trapezia (as c b a d*) into a Triangle, as* c a e.

CONTINUE the Baſe *a d* towards *e* at pleaſure; draw the Diagonal *c d* and *b e* parallel thereto; alſo draw the Line *c e*; then is the Triangle *c a e* equal to the Trapezia *c b a d*; for as the Triangle *c d e* and *c b d* do both ſtand on the Line *c d*, and being between the Parallels *b e* and *c d*, they are therefore equal; and as the Triangle *c b d* is common to both the aforeſaid, therefore the Triangle *c a e* is equal to the Trapezium *c b a d*.

PROBLEM XIX. Fig. T.

To reduce an irregular Pentagon (as c d e a b*) into a Triangle.*

DRAW the Lines *c e* and *c a* from the Angle *b*; draw *b g* parallel to *c a*, and from *d* draw *d f*, parallel to *c e*; draw the Lines *c f* and *c g*, then will the

the Triangle $c f g$ be equal to the irregular Pentagon $c d e a b$, for the same Reason as delivered in the last Problem

PROBLEM XX. Fig. V.

To reduce a Trapezia (as d c a b) into a Triangle i k l, whose Base k l, and one Angle k, is limited.

(1) DRAW $d b$, continue out $a b$; draw $c e$ parallel to $d b$, cutting the Base continued in e, and then drawing $d e$, the Triangle $d a e$ will be equal to the Trapezia $d c a b$. (2) Draw $k l$ equal to the assigned Length of the Base, and on the End k make the Angle $i k l$ equal to the given Angle b.

Now, to find the angular Point i, say, As $k l$, the Base limited, is to $a e$, the Base of the Triangle $d a e$, so is $d f$, the perpendicular Height of the Triangle $d a e$, to the perpendicular Height of the Point i, above the Line $k l$.

Plate CCCCLVI. *Demonstrating the Equality of geometrical Figures.*

PROBLEM I. Fig. A.

There is a Triangle, as a c b, and from a, is drawn a Right-line, as a e d, wherein is a Point, as e, given at Pleasure, from whence 'tis required to draw a Line thro' a c (as e f) in such Manner, that the Triangle c g f cut off, be equal to the Triangle e g a taken in.

THRO' the Point c draw the Line $d c$ parallel and equal to $a b$, to cut the Line $a e d$ in d; join $d a$, and draw the dotted Line $e b$, and from the Point d draw the Line $d f$ parallel to $e b$, cutting $c b$ in f, and draw the Line $e f$; then will the Triangle $c g f$ be equal to the Triangle $e g a$, *which was to be done.*

PROBLEM II. Fig. B.

There is a Triangle, as b a c, and from the End a, there runs a Right-line, as a d e, given; to find how from a given Point, as e, to draw a Line to some Part of the Base c a, (as e f) that the Triangle e f a may be equal to the Trapezia b g c f.

DRAW the Line $e c$, also $b d$, parallel to $c a$, cutting $a e$ in d; from d draw $d f$ parallel to $e c$, and draw $e f$, then is the Triangle $c f a$ equal to the Trapezia $b g e f$, as required.

PROBLEM III. Fig. C.

There is a Triangle, as b c a, from a, is drawn a Line at Pleasure, as a d, and 'tis required, from the Angle c to draw a Line to some Part of a d (as c e) in such Manner, that the Triangle e c a may have Proportion to the given Triangle b a c, as the Line 4 to the Line 5.

BY the Rule of Proportion say, As the Line i 5 is to the Line K 4, so is $b a$ to $g a$; then thro' g draw the Line $g e$ parallel to $c a$, and from the Point e draw the Line $e c$; then will the Triangle $e c a$ be to the Triangle $b c a$, as the Line K 4 is to the Line i 5, as required.

PROBLEM IV. Figures D, E, F.

Two Figures being given, and a Right-line, to find another Line in Proportion to the given Line; as the one Figure to the other.

THE Trapezia *b c d a*, Fig. E, the Triangle *k h f*, and the Line *m* 15, are given to find the Line *n* 40. (1) Reduce the Trapezia *b c d a* into the Triangle *b e a*, and draw its Perpendicular *b o*. (2) Reduce the Triangle *k h f*, Fig. D, into another Triangle, whose Base is equal to *a e*, as the Triangle *g i f*, Fig. D, and let fall its Perpendicular *g p*, then will the Triangle *g i f*, or *h k f*, (which are equal to one another) be in Proportion to the Trapezia, as the Perpendicular *g p* is to the Perpendicular *b o*; now if *g p* were equal to the Line *m* 15, then *b o* would be the Line required; but as it is not, therefore, as the Perpendicular *g p* is to the Perpendicular *b o*, so is the Line *m* 15 to the Line *n* 40.

OPERATION, Fig. F.

DRAW the Angle *b* 14 at Pleasure; make 1 2 equal to the Perpendicular *g p*, and 1 4 to the Perpendicular *b o*; take the given Line *m* 15 in your Compasses, and setting one Foot on the Point 2, the other will fall on the Point 3; from Point 4 draw the Line 4 5 parallel to the Line 2 3, and it will be the Line required.

PROBLEM V. Fig. G.

To divide a Line given into two such Parts as another given Line (whose Length is not more than half the first) may be a mean Proportional between the Parts.

SUPPOSE *h f* be the given Line to be divided, and *a b* a mean Proportional between the Parts to be found.

OPERATION.

BISECT *h f* in *k*, and describe the Semicircle *h e f*; draw *d c* parallel to *k f*, at the Distance of the given Line *a b*, cutting the Semicircle in *e*; draw *e i* at Right-angles to *h f*, dividing *h f* in the Parts *h i* and *i f*, the parts required.

PROBLEM VI. Figures H and I.

To make a Triangle (as h i a) equal in Area to a given Trapezia (as b c d a) and similar to a Triangle given (as e f g).

REDUCE the Trapezia *b c d a* into the Triangle *b h a*, and at the End *a* make the Angle *h a i* equal to the Angle *e g f*; at the End *h* make the Angle *a h i* equal to the Angle *g e f*, and draw the Line *h i*, to cut the Line *a i* in the Point *i*, then will the Triangle *h i a* be similar to the Triangle *e f g*; but as 'tis not equal to the Trapezia *b c d a*, therefore from *b* draw *b k* parallel to *h a*, to cut *a i* in *k*, then will the Triangle *a k h* be equal to the Triangle *b h a* (as being on the same Base *h a*, and between the same Parallels *k b* and *h a*) but as the Angle at *h* is not equal to the Angle *f e g*, therefore from the Point *k* draw the Line *k l* parallel to *i h*, to cut *h a* in *l*; this being done, find a mean Proportional between *a l* and *a h*, which is *a m*, and from the Point *m* draw the Line *m n*, to cut the Line *a i* in *n*, then will the Triangle *a n m* be equal to the Trapezia *b c d a*, and similar to the Triangle *e f g*, as required.

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PROBLEM VII. Fig. A.

To reduce a Parallelogram (as c b d a) into a Parallelogram (as n m d l) whoſe Breadth ſhall have Proportion to its Length, as the Line e e 32 *is to the Line* K 72.

FIND a mean Proportional between the given Lines *e e* 32 and K 72, which is *g g* 48; find alſo a mean Proportional between the Breadth *b a* and the Length *c b*, which is *k k* 72; then if *g g* 48 give *k k* 72, what will K 72? Anſwer *f f* 108; for as 48 is to 72, ſo is 72 to 108. And again, if *g g* 48 give *k k* 72, what will *e e* 32? Anſwer the Line L 48; for as 48 is to 72, ſo is 32 to 48. Continue *d a* to *l*, making *d l* equal to *f f* 108; alſo make *d n* equal to L 48; draw *n m* parallel to *d l*, and *l m* parallel to *n d*, then the Parallelogram *n m d l* will be equal to the Parallelogram *c b d a*, having its Breadth to its Length, as the Line *e e* 32 to the Line K 72, as required.

PROBLEM VIII. Fig. N.

To increaſe or decreaſe a Plan given, according to any Proportion aſſigned.

SUPPOSE *c b d e a* be a Plan given to be decreaſed in Proportion as the Lines *k* to *l*. Add the Lengths of the Lines *l* and *k* into one Sum, and then ſay, As the Sum of thoſe two Lines is to any one of them, (ſuppoſe *l* the ſhort one) ſo is the Length of any given Side of the Plan, (ſuppoſe *b a*, to *b f*) the Quantity of its Decreaſe; or as the Sum of theſe two Lines is to *k*, the longeſt, ſo is the Length of any given Side of the Plan (as aforeſaid) to *a f*, the Length of the Side of the diminiſhed Plan: From *a*, the End of the Side *f a*, draw Right-lines into the Angles *c* and *d*; from the Point *f* draw *g f* parallel to *c b*; from *g* draw *g h* parallel to *d c*, and from *h* draw *h i* parallel to *d e*, then will the Plan *g f h i a* be diminiſhed in Proportion to the given Plan *c b d e a*, as the Line *k* is to the Line *l*, as required.

IF the Plan *f g h i a* had been given for to be enlarged, as the Line *l* is to the Line *k*, then the Point *b* muſt have been found as following, *viz* As the Line *k* is to the Line *l*, ſo is *a f*, the given Side of the Plan, to *f b* its Increaſe, and which being found, and the Lines *a g*, *a h*, and *a i* continued out at Pleaſure, from the Point *b* draw the Line *b c* parallel to *g f*, alſo *c d* parallel to *g h*, and *d e* parallel to *h i*, and then will the increaſed Plan *c b d e a*, be to the given Plan *g f h i a*, as the Line *l* is to the Line *k*, as required.

PROBLEM IX. Figures S, T.

A Trapezia being given (as e b d a, Fig. T) *to make two other Figures equal to it, but each of thoſe two ſimilar to the Parallelogram* O, *another Figure given; and yet the leſſer to have Proportion to the greater, as the Line* E 9 *to the Line* F 16.

(1) REDUCE the Trapezia *e b d a* into the Triangle *b h a*, and that Triangle into a geometrical Square, whoſe Side will be equal to the Line P R, and Area to 750. (2) Reduce the Parallelogram O alſo into a geometrical Square, whoſe Side will be equal to the Line Q, and Area to 120. (3) Reduce the Trapezia *e b d a* into a Parallelogram, ſimilar to the Parallelogram O, as following, *viz.* As the Line E, is to the Line F, ſo is the Length of the Parallelogram O, to the Length of the greateſt Parallelogram in Fig. S; and as the Line E is to the Line F, ſo is the Breadth of the Parallelogram O, to the Breadth of the greateſt Parallelogram in Fig. S; and which Parallelogram is equal to the Trapezia *e b d a*, and ſimilar to the given Parallelogram O. (4) Divide the Length of the greateſt Parallelogram, Fig. S, into two parts, ſo

that

that thoſe parts may have the ſame Proportion to each other as the Lines E and F have to each other, and raiſe the dotted Perpendicular, to cut the Arch of a Semicircle deſcribed on the Side of the Parallelogram, from which Point draw Right-lines to the Extreams of the Parallelogram's upper Side, thereby forming a right angled plain Triangle, whoſe Sides that contain the Right-angle are the Lengths of the two Figures required.

THE Breadths of theſe upper two Parallelograms are thus to be found, *viz.* as the Length of the given Parallelogram O, is to its Breadth, ſo is the Length of either of theſe two Parallelograms to the Breadth required. As the Breadths of theſe Parallelograms are found by the *Ratio* of the Parallelogram O, they are therefore ſimilar to it; and if both their Areas are added together, the Sum will be equal to the Trapezia *e b d a*, as required.

PROBLEM X. Fig. V.

To reduce a regular Polygon (as the Hexagon a f c e d) into a geometrical Square.

THRO' its Center *g* draw a Right-line *m h* at Right-angles to a Side; make *g m* equal to half its Circumference; on *g* raiſe the Perpendicular *g r*, of Length ſufficient to cut the Semicircle *m r h*, deſcribed on the Line *m h* in the Point *r*, then is the Line *r g* the Side of the Square required, and a mean Proportional between *m g*, the *Semiperimeter*, or half Circumference, and *g h* the Semidiameter.

PROBLEM XI. Figures W, X.

To reduce an irregular Plan (as c a h g f e d) into a geometrical Square.

(1) DRAW the Lines *d h* and *e g*, Fig. W, which will divide the Whole into two Trapezia's and one Triangle. (2) Draw the Diagonals of the Trapezia's *a d* and *h e*, and let fall Perpendiculars thereon from the Angles *c, h, d, g, f*. (3) Reduce every Triangle into a geometrical Square, and note their ſeveral Sides, as *i, k, l,* &c. (4) Add the ſeveral geometrical Squares together in Manner following, *viz.* Take the Sides of any two Squares and find a mean Proportional to them, which will be the Side of a Square equal to both of them; proceed on in like Manner to find mean Proportionals until there be not any Squares remaining, and the laſt Proportional will be the Side of a Square, equal to the irregular Plan *c a h g f e d*, as required.

PROBLEM XII. Fig. Z.

To reduce a Circle into a geometrical Square.

AS the ſquaring of the Circle has been a Work attempted by many more able Pens than that of mine, which in general have failed of their deſired Exactneſs, I ſhall therefore in this Place content myſelf with delivering a Rule, that will come ſufficiently near for all Kinds of Buſineſs, relating to Buildings in general, without troubling my Readers with a long Series of Calculations for that Purpoſe, as many have done, more for the Sake thereof than any real Uſe in Buſineſs.

Let o f g a be a Circle given to be reduced into a Geometrical Square (as c b d a.

PRACTICE. Continue the Diameter *g o* towards *h* at pleaſure, on the Center *a* erect the Perpendicular *a b* of Length at pleaſure; divide the Diameter *o g* into 7 equal parts, and make *a n* equal to three Diameters and

one

one 7th of the Diameter. From *f* draw *f k* parallel and equal to *b a*, and join *k b*, then is the Parallelogram *k f b a* equal to the Area of the Circle: Laſtly, biſect *b g* in *o*, whereon, with the Radius *o b*, deſcribe the Semicircle *b b g*, continue *a f* to *b*; now, as *a g* is equal to *a f*, therefore *a b* is a mean Proportional between the Length and Breadth of the Parallelogram *k f b a*, and the Side of a Square equal to the Area of the Circle, as required.

THE Circle aforeſaid may be reduced into a right-angled plain Triangle, by continuing *b k* to *e*, making *k e* equal to *k b*, and drawing the Line *e a*; for by the firſt Propoſition of the eleventh Book of *Euclid*, every Circle is equal to that right-angled Triangle, of whoſe containing Sides the one (as *b a*) is equal to half the Circumference, and the other *e b* to twice *f a*, equal to the Diameter.

PROBLEM XIII. Fig. V.

To reduce an irregular Plan (as l c b a g f e) of many Sides, into a right-lin'd Triangle, as a p o.

(1) DRAW the Line *g e*, alſo *f k* parallel to *g e*, and draw the Line *g k*. (2) Draw the Line *a k*, and from *g*, the Line *g o* parallel to *a k*, and draw the Line *a o*, cutting the Line *l e* continued in *o*. (3) Draw the Line *b l*, and from the Point *c* the Line *c d* parallel to *b l*, and draw the Line *b d*. (4) Draw the Line *a d*, continue out *e d* towards *p* at Pleaſure; from the Point *b* draw the Line *b p* parallel to *a d*, cutting *k d* in *p*, and drawing *a p*, the Triangle *a p o* will be equal to the irregular Plan *l c b a g f e*, as required.

PROBLEM XIV. Figures *g*, *f*, &c.

To reduce a Geometrical Square (as b a c d) into the Figure of a Lunula, as g e f a.

CONTINUE *b a* to *e*, making *b e* equal to *b a*; on *b*, with the Radius *b a*, deſcribe the Semicircle *e g a*; alſo on *c*, with the Radius *e c*, deſcribe the Arch *e f a*, then is the *Lunula g e f a*, equal to the Square *b a c d*, as required.

Plate CCCCLVII. *Arithmetick geometrically demonſtrated.*

I. NUMERATION.

AS Right-lines are compoſed of Points, ſo are Numbers of Units. A Unit ſignifies *one*, as a Man, a Tree, a Line, a Square, a Circle, *&c.* ſo the Right-line *a b*, Fig. I. is a Unit, as not being divided into two parts, as *c b*. The Circle *f d b h*, Fig. II. the Square *e f g h*, and Parallelogram *b c d e*, being conſidered as undivided Figures, are alſo Units, or *One*'s, tho' of different Kinds.

IF a Unit be divided into equal parts, the parts are called Fractions, or fractional parts of the Unit.

So in Fig. I. the Lines below are divided, with their fractional parts thus expressed, part of the Line $a b$, which is equal to each of the Lines $c b$, $e b$, &c. wherein those fractional parts are represented:

So in Fig. I.	is divided into	equal parts, which are called	and are thus expressed
$c b$	2	one half	$\frac{1}{2}$
$e b$	3	one third	$\frac{1}{3}$
$h b$	4	one fourth	$\frac{1}{4}$
$m b$	5	one fifth	$\frac{1}{5}$
$r b$	6	one sixth	$\frac{1}{6}$
$s b$	7	one seventh	$\frac{1}{7}$
$t b$	8	one eighth	$\frac{1}{8}$
$v b$	9	one ninth	$\frac{1}{9}$
$w b$	10	one tenth	$\frac{1}{10}$
$x b$	11	one eleventh	$\frac{1}{11}$
$y b$	12	one twelfth	$\frac{1}{12}$

part of the Line $a b$, which is equal to each of the Lines $c b$, $e b$, &c. wherein those fractional parts are represented.

HENCE 'tis plain, that a part is a Magnitude of a Magnitude, a less of a greater, when the less measureth the greater. If the Line hd be drawn thro' the Center of the Circle, Fig II. then each Semicircle is half of the Unit, and that intersected by the Line $a b$ quite through the Center, from Side to Side, at Right-angles, will divide each Semicircle into 2 Quadrants, each equal to one 4th of the Unit.

IN like manner, the Arch $c b$ being one 6th of the whole Circumference, the Sector $c a b$ is one 6th of the Unit; so likewise $e a d$ is one 8th, also $d a c$ one 12th, and $f a e$ one 16th of the Unit.

THE geometrical Square $e f g h$, Fig. III. being divided as in the Figure, the Squares a, b and c are each one 4th part of the Unit $e f g h$; so likewise the Squares a and b taken together are 1 half; the Squares a, b and c taken together are three 4ths; and the Parallelogram c or e is one 8th of the Unit $e f g h$.

IF the Unit be a Parallelogram, as $h c d e$, Fig. IV. and have its Sides and Ends divided, each into any Number of equal parts, (suppose each into six) and Lines be drawn from Side to Side, and from End to End, as in the Figure, those little Parallelograms will be fractional parts of the Unit; and as there are just 36 of them in the Unit,

therefore		is	or
	a	$\frac{1}{36}$	
	$a f$	$\frac{2}{36}$	$\frac{1}{18}$
	$a f g$	$\frac{3}{36}$	$\frac{1}{12}$
	$a f g h$	$\frac{4}{36}$	$\frac{1}{9}$
	$a f g h i$	$\frac{5}{36}$	
	$a f g h i k$	$\frac{6}{36}$	$\frac{1}{6}$

THE lowermost Number of every fractional Quantity denotes the Number of parts, into which the Unit is divided, as in this Example is 36, and is therefore called the Denominator. The uppermost Number of a Fraction is called the Numerator, because it expresses what part of the Whole, or how many of the parts, into which the Unit is divided, is to be understood; and so, if a Pound sterling, or 20 Shillings, be considered as an Unit, then one Shilling is one 20th, two Shillings is two 20ths, or one 10th, three Shillings is three 20ths, &c. and in like manner, if a Foot in Length be considered as an Unit, then one Inch is one 12th, two Inches is two 12ths, or one 6th, three Inches is three 12ths, or one 4th, &c.

II. ADDITION.

As by the 47th Proposition of the first Book of *Euclid* the Sum of the Squares, made on the Legs of a right-angled plain Triangle, are equal to the Square made on the Hypothenuse, the Addition of the Area's of geometrical Figures is very easy; for if the Area's to be added are first reduced into Squares, as before taught, this Proposition will add them together into one Sum. To make this Proposition to be understood to the meanest Capacity, Let the right-angled Triangle $k m l$, Fig. V. have its Legs $k m$ and $m l$ equal; compleat

compleat the Squares *q k p m*, *m l n o*, and *s k r l*, continue *q k* to *r*, *o l* to *s*, and draw the Diagonal *q m o*. Now, 'tis plain that the Triangle *h* is equal to the given Triangle *e*, becaufe it ftands on the fame Bafe *m l*, and is between the fame Parallels *k l* and *q o*; and as *n o* is equal and parallel to *m l*, and *m n* to *l o*, therefore the Triangle *i* is equal to the Triangle *h*, and to the Triangle *e* alfo; for the fame Reafons the Triangles *f* and *g* are each equal to the Triangle *e*. Again, as *k t* is equal and parallel to *m l*, and *t l* to *k m*, therefore the Triangle *c* is equal to the Triangle *e*; and as *s t* is equal to *t l*, and *k s* to *k l*, and as *k t* is common to both, therefore the Triangles *a* and *c* are equal, as likewife are the Triangles *b* and *d*, becaufe *t r* is equal to *k t*, *s r* to *s k*, and *r l* to *l k*. Now, feeing that all the Triangles *a*, *b*, *c*, *d*, *f*, *g*, *h*, *i*, are equal to each other, therefore the Triangles *a*, *b*, *c*, *d*, which compofe the Square *s k r l*, are equal to the Triangles *f g*, *h i*, which compofe the Squares made on the Legs of the Triangle, *as was to be proved.*

THIS is alfo proved arithmetically, by the Squares of the Numbers 3, 4, and 5, as in Fig. VI. Suppofe a right-angled Triangle, as *b c a*, whofe Side *b c* is 3, that of *c a* is 4, and the Hypothenufe *b a* is 5, compleat their Squares, dividing each Side, and draw the Lines in each as in the Figure. Now, 'tis plain that the Square *e b d c*, whofe Side is 3, contains 9, and that the Square *c a f g*, whofe Side is 4, contains 16, which added together is equal to 25, and which are equal to the Square *h i b a* 25, whofe Side is 5.

HENCE 'tis evident, that making the Sides of any two Squares given, the Legs of a right-angled Triangle, the Hypothenufe is the Side of a Square, whofe Area is equal to the two Squares given.

EXAMPLE Fig. VII.

Let the Geometrical Squares a, b, c, d, e, be given, to be added into one Geometrical Square.

(1) MAKE the Legs of the right-angled Triangle *f g i* equal to the Sides of any two of the given Squares, fuppofe of the Squares *a* and *b*, then the Square *h g f i*, on the Hypothenufe, is equal to the Squares *a* and *b*. (2) Make the Legs of the Triangle *m n o* equal to *f i*, the Side of the Square *k*, and to one Side of the Square *c*, then will the Square *m q p o*, made on the Hypothenufe *m o*, be equal to the Squares *a*, *b*, and *c*. (3) Make the Legs of the Triangle *t s r* equal to the Side of the Square *q p m o*, and Side of the Square *d*, then is the Square *t v r w* equal to the Squares *a*, *b*, *c*, *d*. (4) Make the Legs of the Triangle 3 1 2 equal to *t r*, the Side of the Square *x*, and to the Side of the Square *e*, then is the Square 5 3 4 2 equal to the given Squares *a*, *b*, *c*, *d*, *e*, as required.

EXAMPLE II. Fig. VIII.

There is given the Triangle a, the Geometrical Square b, the Parallelogram c, the Rhombus d, the Rhomboides e, and the Trapezia f, to be added into one Geometrical Square, as Fig. IX.

(1) REDUCE all thefe given Figures, the Square excepted, into Geometrical Squares, as before taught, the Manner of which is reprefented by the 5 Semicircles under Fig. VIII. and then add them together, as in the laft Example.

III. SUBSTRACTION.

SINCE that in Addition the Square made on the Hypothenufe is equal to both the Squares made on the Legs, therefore in Subftraction the Sum given muft be always confidered as the Square made on the Hypothenufe, the Sum

to

to be ſubſtracted, a Square on one of the Legs, and the Remainder a Square on the other Leg.

EXAMPLE I. Figures C, E, D.

From the Square C *ſubſtract the Square* D, *and ſhew the Remainder in a Square, as* E.

DRAW *g h* of any Length, and erect the Perpendicular *g f* at Pleaſure; make *g h* equal to the Side of the Square that is to be ſubſtracted; on *h*, with the Side of the Square C, deſcribe the Arch *e e*, cutting the Perpendicular in *f*, then is *f g* the Side of the Square, equal to the Remainder, required.

EXAMPLE II. Figures A, B, C.

From the Square A *ſubſtract the Square* B, *and ſhew the Remainder in a Square, as* C.

MAKE a Right-angle at Pleaſure, as *c b d*, make *c b* equal to the Side of the Square B; on the Point *c*, with the Side of the Square A, deſcribe the Arch *a a*, cutting *b d* in *d*, then is *b d*, the Side of the Square C, equal to the Remainder required. As under theſe two Examples all others happen, therefore 'tis needleſs to ſay any more hereon.

IV. MULTIPLICATION.

I. *Of Units, or Integers,* Fig. IX.

IF the Line *a b* divided into 4 parts, and conſidered as ſo many Units, be multiplied by the Line *a c*, divided into 4 parts, or Units alſo, the Product will be 16 Units; for if from the parts in both the Lines *a b* and *a c*, Right-lines are drawn parallel to themſelves, they will together produce the great Square *a b c d*, divided into 16 ſmall Squares, each of which is a Unit, as being a Square produced by the Multiplication of 1 into 1; and ſo the like of all other Multiplications of whole Numbers, or Units in general.

II. *Of Units, or whole Numbers and Fractions,* Fig. X.

EXAMPLE I.

MULTIPLY the Line *e g* equal to 4 Feet and a half, by *e i*, equal to 4 Feet and a half. The Lines being divided, and their Parallels drawn, 'tis evident that the Product is the Square *e g i z*, divided into 16 Squares or Units, produced by the Multiplication of the Units, and into 8 Parallelograms, as *n n*, &c. each of which is equal to half a Unit, as being a Unit in Length, and but half a Unit in Breadth, together with the little Square *o*, which is but one 4th of a Unit, as being but half a Unit in Length, and the ſame in Breadth. The Sum of which Products is as follows.

The Produce of the Units 4 into 4	16	0
The Produce of *e i* 4 into one half	2	0
The Produce of *o z* 4 into one half	2	0
The Produce of the Square *o* $\frac{1}{2}$ into one half	0	$\frac{1}{4}$
Sum	20	$\frac{1}{4}$

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EXAMPLE II. Fig. XI.

MULTIPLY the Line *d a* equal to 4 Feet one 4th, by the Line *d g*, equal to 4 Feet and one 4th.

	Feet	Inches	Parts
In this Example the Produce of the Units 4 into 4, is	16	0	0
The 4 Parallelograms, or Quarters of Units, between *d* and *h*, equal to	1	0	0
The 4 Parallelograms, or Quarters of Units, between *n* and *b*, equal to	1	0	0
The little Square at *g* is 3 Inches, into 3 Inches, equal to one 16th or	0	0	9
Sum	18	0	9

EXAMPLE III. Fig. XII.

MULTIPLY the Line *a c*, equal to 4 Feet and 9 Inches, by *c e*, 4 Feet 9 Inches.

	Feet	Inches	Parts
The Produce of the Units is 4 into 4, equal to	16	0	0
The Parallelograms *m, m*, &c. 4 Feet by 9 Inches, twice, equal to	6	0	0
The little Square *n* is 9 Inches into 9 Inches, equal to	0	6	9
Sum	22	6	9

EXAMPLE IV. Fig. XIII.

MULTIPLY the Line *a c*, equal to 7 Feet and a half, by the Line *c g*, 4 Feet and a half.

	Feet	Inches	Parts
The Produce of the Units is 7 into 4, equal to	28	0	0
The Produce of the Parallelograms *n, n*, &c. is 7 Feet into 6 Inches, equal to	3	6	0
The Produce of the Parallelograms *i, i*, &c. is 4 Feet into 6 Inches, equal to	2	0	0
The Produce of the little Square *o*, is 6 Inches into 6 Inches, equal to	0	3	0
Sum	33	9	0

NOW, from the preceding 'tis plain, that Units multiplied into Units their Number is increafed, but Fractions multiplied into Fractions their Number is decreafed; for if one 4th be multiplied by one 4th, as in Fig. XVII. that is *a b*, or one 4th of *e b*, by *b d*, or one 4th of *b g*, the Product is the little Square *a b c c*, which is but one 16th part of *e b f g*; and fo in like Manner, if one half be multiplied by one half, as *b a* by *d e*, the Product is the Square *b a d c*, which is but one 4th of *e a g h*.

THE Figures XIV. XV. XVI. and XVII. are other Examples of Feet and Inches multiplied into Feet and Inches, for further Practice.

Plate CCCCLVIII. *Multiplication of Feet, Inches and Parts.*

EXAMPLE, Fig. I.

MULTIPLY the Line *a c* equal to 2 Feet 5 Inches and a half, by *a l*, 2 Feet 11 Inches and three 4ths. The Line *a c* being divided into 2 Feet 5 Inches and a half, and the Line *a l* into 2 Feet 11 Inches and three 4ths, place them at Right-angles to each other, and from the Divifions of the Feet, Inches and Parts in each Line, draw parallel Right-lines, as in the preceding Examples, then their Produce will be as follows, *viz.*

	Feet	Inches	Parts
The Produce of the Units *a b* 2, by *a g* 2, is equal to	4	0	0
The Produce of the Parallelograms *m m*, &c. 2 Feet into 5 Inches, is equal to	0	10	0
The Produce of the Parallelograms *o o*, &c. 2 Feet into 11 Inches, is equal to	1	10	0
The Produce of the Parallelograms *i s*, *p r*, 11 Inches into 5 Inches, is equal to	0	4	7
The Produce of the Parallelograms *n*, *n*, 2 Feet into half an Inch, is equal to	0	1	0
The Produce of the Parallelograms *p*, *p*, 2 Feet into three 4ths of an Inch, is equal to	0	1	6
The Produce of the Parallelograms *s s s*, &c. 11 Inches into half an Inch, is equal to	0	0	5½
The Produce of the Parallelograms *q q*, &c. 5 ~~4~~ Inches ~~and a half~~ into three 4ths of an Inch, is equal to	0	0	3¾
The Produce of the Parallelogram *r*, half an Inch into three 4ths of an Inch, is equal to	0	0	0⅜
Product	7	3	10⅝

Division of Geometrical Figures.

PROBLEM I. Fig. III.

To divide a Triangle (as b c a) according to a Proportion assigned, by a Line drawn from an Angle (as b) given; the Proportion of its Parts to be as the Line d is to the Line e.

(1) PLACE the Lines *d* and *e* together, so as to make one Right-line, noting their Point of Contact. (2) Divide *c a* in *f*, in the same Proportion, and from *b* draw the Right-line *b f*, then will the Triangle *b f a*, be to the Triangle *b c f*, as the Line *d*, is to the Line *e*.

PROBLEM II. Fig. III.

To cut from a Triangle, a Part equal to a Figure given, and to lay the Part cut off towards any Place appointed.

THE Triangle given is *b c a*, the Figure given is *h i g*, the Part cut off, to be next to the Side, *c*. Increase the Side *i h* to *k*, reduce the Triangle *h i g* into the Triangle *k i l*, whose Perpendicular may be equal to the Perpendicular of the Triangle *b c a*; make *c f* equal to *i l* (because it was required to lay the Part cut off next to *c*) and draw the Line *b f*, then will the Triangle *b c f* be equal to *h i g*, as required.

PROBLEM III. Fig. III.

To make a Triangle to contain any Number of Acres, Roods and Poles.

SUPPOSE 3 Acres, 1 Rood, and 20 Poles. (1) Reduce the Acres into Poles by multiplying them by 160, the Number of Poles in an Acre, also reduce the 1 Rood into Poles, by multiplying it by 40, the Number of Poles in a Rood, which add to the 20 Poles, and the Sum Total will be 540 Poles. (2) Double 540, the Number of Poles, and the Sum is 1080; now, assign the Base of a Triangle at pleasure, suppose of 40 Poles in Length, by which divide 1080, and the Quotient is 27, which is the perpendicular Height of the Triangle; for as 40 multiplied by 27, produces a Parallelogram equal to 1080, if that Parallelogram be divided by a Diagonal Line into two equal parts, or Triangles,

Triangles, then each will have its Bafe equal to 40, and each Perpendicular equal to 27, as aforefaid, and confequently each Triangle will be equal to 540 Poles, as required. Now, if the Line *i g* reprefent 40 Poles, at the Diftance of 27 Poles draw a Line parallel to *i g*, as *h m*, wherein affign any Point, as at *h*, and draw the Lines *h g* and *h i*, and then the Triangle *h i g* will be a Triangle containing 3 Acres, 1 Rood and 20 Poles, as required.

PROBLEM IV. Fig. II.

To divide a Triangle given (as b c a) into two parts in Proportion, according to two Lines given, (as f, e) with a Line drawn from a Point (as d) in any Side affigned (as c a).

DIVIDE the Line *c a* in the Point *d*, fo that *c d* may be to *d a*, as the Line *e* to the Line *f*, and from the oppofite Angle *b* draw the Line *b d*; bifect *d a* in *g*, and from *g* draw *g h* parallel to *b a*, and draw *h d*; then will the Triangle *h d a* be in Proportion to the part *b h c d*, as the Line *e* to the Line *f*, as required.

PROBLEM V. Fig. II.

To cut from a Triangle given (as b c a) a Part (as h d a) equal to a Figure given, (as k i i) with a Line drawn from a given Point (as d) in any Side affigned (as c a).

REDUCE the Triangle *k i i* into the Triangle *m n i*, whofe Perpendicular may be equal to the Perpendicular of the Triangle *b c a*; draw from the given Point *d* a Line to the oppofite Angle *b*; make *a g* equal to *n i*, the Bafe of the Triangle *m n i*, and draw *g h* parallel to *b d*, and draw the Line *h d*; then will the Triangle *h d a* be equal to the given Triangle *k i i*, as required.

PROBLEM VI. Fig. VI.

To divide a Triangle given, according to a Proportion affigned, with a Parallel to one of its Sides.

SUPPOSE the Triangle *b c a* be given to be divided into two parts, in Proportion one to the other, as the Line *d* to the Line *e*, with a Parallel to the Side *b c*: Divide the Bafe *c a* in *f*, fo that *c f* may be to *f a*, as the Line *d* to the Line *e*, and find a mean Proportion between *a f* and *a c*, which is *g a*; by *g* draw a Parallel to the Side *b c*, as *h g*; then will the Triangle *h g a* be to the Remainder *b h c g*, as the Line *e* is to the Line *d*, as required.

PROBLEM VII. Fig. VI.

To cut from a given Triangle (as b c a) a part (as h g a) equal to a Figure given, (as the Parallelogram l k p i) with a Parallel to one of its Sides (as b c).

(1) INCREASE *i k*, the Side of the Parallelogram *l k p i*, towards *o* at pleafure; make *k n* equal to *i k*, and draw the Line *n p*; then will the Triangle *n p i* be equal to the Parallelogram *l k p i*, becaufe the Triangle included above *k* is equal to the Triangle excluded between *l* and *p*. (2) Reduce the Triangle *n p i* into another Triangle, as *o m i*, whofe Perpendicular may be equal to the given Triangle *b c a*, whofe Bafe is *m i*. (3) Find a mean Proportion between the Bafes *m i* and *c a*, which is *g a*, by which Point *g*, draw a Line parallel to the Side *b c*, as *h g*; then will the Triangle *h a g* cut off, be equal to the given Parallelogram *l k p i*, as required.

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PROBLEM VIII. Fig. V.

To divide a Triangle (into two parts, by a Right-line drawn parallel to a Right-line given) according to any Proportion assigned between two given Right-lines.

SUPPOSE the Triangle *b c a* be given, as also the Right-line *d*, situated as in the Figure; and 'tis required to divide the Triangle *b c a* into two parts, by a Line drawn parallel to the given Line *d*, so that the parts divided may have Proportion the one to the other, as the Line *f* to the Line *e*. (1) Divide the Base *c a* in *g*, so that *c g* may be to *g a*, as the Line *f* to the Line *e*, and from the Angle *b* draw *b h* parallel to the given Line *d*, cutting *c a* in *h*. (2) Find a mean Proportional between *h a* and *g a*, which is *i a*, and from *i* draw the Line *i k* parallel to *b h*; then will the Triangle *b c a* be divided by the Line *k i* into the parts *b k c i* and *k i a*, which have the same Proportion to one another, as the Line *f* to the Line *e*, as required.

PROBLEM IX. Fig. V.

To cut off from a Triangle a part equal to a Figure given, with a Right-line parallel to a Right-line assigned.

SUPPOSE *b c a* be a Triangle given, from which 'tis required to cut off the part *k i a* by the Line *k i*, that shall be equal to the given Square *n m e l*, and the Line *k i* parallel to the Line *d*. (1) Draw *b h* parallel to the Line *d*, to cut the Base *c a* in *h*; increase *o n*, the Side of the Square *n m o l*, towards *q* at pleasure, and make *n p* equal to *n o*, and draw the Line *p l*; then will the Triangle *p o l* be equal to the Square *n m o l*. (2) Reduce the Triangle *p o l* into the Triangle *q o r*, whose Perpendicular *q o* may be equal to the Perpendicular of the Triangle *b c a*, and make *g a* equal to *o r*, the Base of the Triangle *p o r*. (3) Find a mean Proportional between *a g* and *a h*, which is *a i*, and from *i* draw *i k* parallel to *b h*; then will the Triangle *k i a* cut off, be equal to the given Square *n m e l*, as required.

PROBLEM X. Fig. IV.

To divide a given Triangle into two parts, according to any Proportion given, by a Line drawn from a Point assigned without the Triangle.

SUPPOSE *b k c* be the given Triangle, *d* the given Point, and the Lines *e*, *f* the given Proportion. (1) Increase the Side *b k* towards *g* at pleasure, and from the Point *d* draw the Line *d g* parallel to *c k*, cutting *b k* continued in *g*. (2) Divide *b k* in *h*, so that *b h* may be to *h k*, as the Line *f* to the Line *e*. (3) As *d g* is to *c k*, so is *h k* to *h i*. (4) Find a mean Proportion between *k g* and *k i*, as *l k*; bisect *i k* in *a*, and draw *l a*, and make *a m* equal to *l a*. (5) Draw a Right-line from *d* to *m*, then will *m k t*, the Triangle cut off, be in Proportion to the Trapezia remaining of the given Triangle *b k c*, as the Line *e* to the Line *f*, as required.

PROBLEM XI. Fig. IV.

To cut from a Triangle a Part equal to a Figure given, with a Line drawn from a Point assigned without the Triangle.

SUPPOSE *b k c* be a given Triangle, *d* a given Point without, and the Trapezia *m q o p* the Figure given. (1) Increase *b k* to *g*; from the given Point *d*, draw *d g* parallel to *c k*, to cut *b k* continued in *g*. (2) Reduce the given Trapezia *m q o p* into the Triangle *m n o*, and that into the Triangle *m q s*, whose

whofe perpendicular Height may be equal to the perpendicular Height of the given Triangle *b k c*, from *c* upon *k b* being continued; make *k h* equal to *m q*. Now, as *d g* is to *c k*, fo is *k h* to *k i*, which fet from *k* to *i*. (3) Find a mean Proportional between *k g* and *k i*, as *l k*; bifect *k i* in *a*, and draw the Line *l a*; alfo make *a m* equal to *a l*, and from the given Point *d* to the Point *m* draw the Line *m d*, which will cut the Triangle *k m t* equal to the Trapezia *m q o p*, as required.

Plate CCCCLIX. *The Divifion of Geometrical Figures demonftrated.*

PROBLEM I. Fig. I.

Thro' a given Point, within a Triangle, to draw a Right-line that fhall divide the Triangle according to any (poffible) Proportion, between two given Right-lines.

Suppose *p q v* be a given Triangle, and *d* the Interfection of the Line *n t*, with the Line *r s*, be the given Point, and the parts of the Triangle to be to each other as the Line *a* to the Line *b*. (1) Confider which Sides of the Triangle the Line of Partition *s r* muft pafs, which let be *p v* and *q v*, and thro' the given Point draw the Line *n t* parallel to the Side *o v*, to cut the Line *q v* in *t*. (2) Divide the Bafe *q v* in *i*, fo that its parts may have the fame Proportion to each other as the Line *a* to the Line *b*. (3) Now, if *t v* (that Part of the Bafe cut by the Parallel *n t*, adjoining to that Side unto which the Parallel was drawn, *viz. p v*) give the half Perpendicular from *p* upon the Bafe *q v*, what will *q i*, the leffer Segment of the Bafe? Anfwer, a Line, (which find by the Rule of Proportion already taught) and, at the Diftance equal to its Length, draw a Parallel to the Bafe, as *m m*, to cut the Side *v p*; being continued, if required, in the Point *o*, make *q r* equal to *i t*, and draw *r s*, then will the Triangle *s r v*, cut off by the Line *s r*, have the fame Proportion to the remaining part *p s q r*, as the Line *b* to the Line *a*; for taking the Square of *k l* equal to *t d*, from the Square of *l i*, equal to *d n*, the Remainder is the Square of *k i* equal to *o s*, from whence through the given Point *d*, the Line of Partition being drawn to the Bafe at *r*, the Triangle *s r v* will therefore have the fame Proportion to the part *p s q r*, as aforefaid.

PROBLEM II. Fig. I.

To cut from a Triangle a Part equal to a given Figure, whofe Area is lefs than the Area of the Triangle, by a Line drawn thro' a given Point within the Triangle.

Suppose the Triangle *p q v* be the given Triangle *d e g h*, the given Figure, and the given Point within the Triangle to be the fame as in the laft Problem. (1) Reduce the given Trapezia *e d g h* into the Triangle *e f h*, and that again into the Triangle *c g h*, whofe perpendicular Altitude is equal to the perpendicular Altitude of the Triangle *p q v*, whofe Bafe will be *g h*. (2) Confider thro' which Sides of the Triangle the Line of Partition muft pafs, which in this Example are the Sides *p v* and *q v*, therefore thro' the given Point draw a Right-line parallel, as *n t*, to the Side *p v*. (3) Make *v i* equal to *g h*, and then fay, If *t v*, part of the Bafe of the Triangle *p q v*, give half its Perpendicular from *p* upon *q v*, what will the Length *q i* give? Anfwer, a Line, at whofe Length draw a Right-line, as *m m*, parallel to *q v*, to meet the Side *v p* (continued if need be) in the Point *o*; make *q r* equal to *i t*, and draw the Line *r s*, cutting the dotted parallel Line *n t* in *d*, the given Point, then will the Triangle *s r v* be equal to the Trapezia *e d g h*; for taking the Square of *k l* equal to *t d*, from the Square of *l i*, equal to *d n*, the Remainder is the Square of *k i*, equal to *o s*, from whence, thro' the given Point *d*, the Line

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of Partition being drawn to the Baſe at *r*, the Triangle *s r v* is therefore equal to the Trapezia *e d g h*, as aforeſaid.

PROBLEM III. Fig. II.

To divide a Trapezia given, according to any Proportion between two Lines, by a Line drawn from an Angle aſſigned, and to lay the part cut off towards a Place appointed.

Suppose the Trapezia *i k m o* be given to be divided into two parts, as the Line *a* to the Line *b*, by a Line drawn from the Angle *k*, and to lay the leſſer part next to the Angle *o*. Reduce the Trapezia *i k m o* into the Triangle *k h o*, whoſe Baſe is *h o*; divide *h o* in *n*, ſo that *n o* be to *h n*, as the Line *a* is to the Line *b*, and draw the Line *n k*; then will *k n o*, the Triangle cut off, be to *i k m n*, the part remaining, as the Line *b* is to the Line *a*, as required. *But here note*, That if the greater part was required to be left towards the Angle *o*, then the Line of Partition drawn from the Angle *k* would have fell upon the Side *i m*, as *k l*, and the Side *c d* muſt have been increaſed to have become the Baſe of a Triangle, into which the Trapezia muſt have been reduced, and which muſt have been divided in *l*, ſo that *i l* to *l p* may be, as the Line *b* to the Line *a*; and ſo in like manner, if it was required to draw a Line from the Angle *i*, then the Side *k o* muſt be increaſed, and the Trapezia reduced into a Triangle, &c. as aforeſaid.

PROBLEM IV. Fig. II.

From a Trapezia given to cut off a part equal to a Figure given, with a Line drawn from an Angle aſſigned, and to lay the Part cut off towards a Place appointed.

Suppose *i k m o* be the given Trapezia, from which a Quantity equal to the Triangle *d f e* is to be cut off next to the Angle *o*, by a Line drawn from the Angle *k*. Reduce the Trapezia *i k m o* into the Triangle *k h o*, alſo the Triangle *d f e* into the Triangle *c g e*, whoſe perpendicular Altitude above its Baſe *g e* may be equal to the perpendicular Altitude of the Triangle *k h o*; make *n o* equal to *g e*, and draw the Line *k n*; then ſhall the Triangle *k n o*, cut off by the Line *k n*, drawn from the Angle *k*, be equal to the Triangle *d f e*, and next to the Angle *o*, as required.

PROBLEM V. Fig. III.

To divide a Trapezia into two parts, according to any Proportion required, with a Line drawn from a Point aſſigned in any of the Sides.

Suppose *d f h l* be the given Trapezia, and *e* a given Point in the Side *d f*, and the Proportion of the parts to each other to be as the Line *b* to the Line *c*. Increaſe the Baſe both Ways to *g* and *m*, and reduce the Trapezia *d f h l* into the Triangle *e g m*, whoſe Baſe is *g m*, which divide in *k*, ſo that *g k* be to *k m*, as the Line *b* to the Line *c*, and draw the Line *e k*; then will the part *d e h k* be to the part *e f k l*, as the Line *b* to the Line *c*, as required.

PROBLEM VI. Fig. III.

To cut from a given Trapezia a part equal to a Figure given, by a Line drawn from a Point aſſigned in any one of its Sides.

Suppose *d f h l* be the given Trapezia, the Point *e*, in the Side *d f*, the aſſigned Point, to cut off a part equal to a Square, whoſe Side is equal to the Line

Line *b*. Reduce the Trapezia into the Triangle *e g m*, alſo reduce the Square, whoſe Side is equal to *b*, into a Triangle, whoſe perpendicular Altitude be equal to the Perpendicular of the Triangle *e g m*, from *e* upon the Baſe *g m*; then will the Baſe of that Triangle be equal to the Line *a*, which ſet from *m* to *k*, and draw *e k*, and the Trapezia *e f k l* cut off will be equal to a Square, whoſe Side is equal to the Line *b*, as required.

PROBLEM VII. Fig. IV.

To divide a Trapezia into two parts, by a Line parallel to one of its Sides, in ſuch Proportion the one to the other, as two given Right-lines; and to lay the part required towards an Angle or Side aſſigned.

SUPPOSE *s q m p* be the given Trapezia to be divided into two parts, in ſuch Proportion to one another, as the Line *h* has to the Line *i*, by a Right-line drawn parallel to the Side *q p*, and to lay the greater part next the Side *s m*. (1) Conſider through which two Sides the Line of Partition muſt paſs, which muſt always be continued until they meet, as *q s* and *p m*, which being continued meet in *k*. (2) Reduce the Trapezia *s q m p* into the Triangle *q l p*, whoſe Baſe is *l p*. (3) Divide *l p* in *n*, ſo that *l n* be to *n p*, as the Line *b* to the Line *c*, the leſſer part being placed next to *p*. (4) Find a mean Proportion between *k n* and *k p*, as *k o*; from the Point *o* draw the Line *o r* parallel to *q p*; then will *r q o p* be the leſſer part next to *q*, which has the ſame Proportion to the part *s r m o*, as the Line *i* to the Line *h*, as required.

BUT if the part required to be cut off had been with a Parallel to *m p*, then the Line of Partition would have paſſed through the Sides *q p* and *s m*, which muſt have been increaſed till they meet; and then proceed in all Points, as before.

PROBLEM VIII. Fig. IV.

To cut from a Trapezia a Part equal to a Figure given, by a Line parallel to one of the Sides, and to lay the Part cut off towards a Place appointed.

SUPPOSE the Parallelogram *a c d g* be given to cut off from the Trapezia *s q m p* a part equal thereto, by a Right-line drawn parallel to the Side *q p*. (1) Conſider through which two Sides the Line of Partition muſt paſs, which here are *s q* and *m p*, which continue, until they meet in *k*. (2) Reduce the Parallelogram *a c d g* into the Triangle *a c e*, and that into the Triangle *a b f*, whoſe perpendicular Altitude be equal to the Perpendicular from *q* on the Baſe *k p*, and Baſe to *a b*. Now, ſeeing that the part to be cut off is to be laid next to *p*, therefore make *p n* equal to *a b*, and find a mean Proportional between *k n* and *k p*, which is *k o*, (3) From the Point *o* draw the Line *o r* parallel to the Side *q p*; then will the part *r q o p* be equal to the Parallelogram *a c d g*, as required.

Note, If the part cut off, equal to the Parallelogram, ſhould have been laid next to the Angle *m*, then the Point *l* muſt have been firſt found, and *a b* muſt have been found, and placed from *m* towards *p*, and then proceeded, as before.

PROBLEM IX. Fig. V.

To divide a Geometrical Square (as d e f g) into two equal Parts, by a Right-line (as b c) drawn thro' a given Point (as b) within the Square.

DRAW the Diagonals *d g* and *e f*, interſecting in *h* the Center; from the given Point *b*, through the Center *h*, draw the Right-line *a c*, which will divide the Square *d e f g* into two equal parts, as required.

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Note, The ſame is to be underſtood of the Parallelogram, Rhombus and Rhomboides.

PROBLEM X. Fig. VI.

To divide a Trapezia into two Parts, according to any Proportion between two Lines, with a Right-line parallel to a Right-line given; and to lay the Part required towards a Place aſſigned.

SUPPOSE $dfgi$ be the given Trapezia to be divided into two parts, in Proportion one to the other, as the Line a to the Line b, by a Right-line parallel to the Line lm, and to lay the greater part next to g. (1) Conſider thro' which Sides the Line of Partition muſt paſs, which here are gi and df, which continue until they meet in the Angle c; from f draw the Right-line fk parallel to the given Line lm, to meet the Baſe gi continued in k. Suppoſe a Line be drawn from f to g, and another parallel thereto from d to the Baſe ck, cutting the Baſe in t; and then ſuppoſing a Line drawn from f to t, the Triangle [illegible] will be equal to the Trapezia $dfgi$. (2) Divide ti, the Baſe of the aforeſaid Triangle, into two parts, at the Point v, ſo that the part iv be to the part vt, as the Line a to the Line b, obſerving to lay the greateſt part next to g, as is required. (3) Find a mean Proportional between cv and ck, which is ch, and from the Point h draw the Right-line he parallel to the Line lm; then will the Trapezia $dfgi$ be divided into two parts, according to the Proportion aſſigned, with the greateſt part next to g, as required.

PROBLEM XI. Fig. VI.

To cut from a Trapezia a Part equal to a Figure given, by a Right-line drawn parallel to a Right-line drawn by Chance, and to lay the Part cut off towards a Place aſſigned.

SUPPOSE the Trapezia $dfgi$ be given, to cut off an Area equal to the Area of the Trapezia $norq$, by a Right-line parallel to the Chance-line lm, and to lay the part cut off next to the Angle i. (1) Conſider thro' which of the Sides the Line of Partition eh muſt paſs, which here are gi and df, which continue until they meet in the Angle c. (2) Reduce the Trapezia $norq$ into the Triangle npr, and that again into the Triangle nos, whoſe perpendicular Altitude may be equal to the Perpendicular from f upon gi continued, then will the Baſe of this new Triangle be no. (3) Set no, from i, towards g, on the Line gi, as to the Point v, and [illegible] Right[illegible] the Chance-line l [illegible] continued in k. (4) Find a mean Proportion between cv and ck, which is ch, and from h draw he parallel to lm, then will the part $efhi$, next to the Angle i, be equal to $norq$, the Trapezia given, as required.

Note, That what has been hitherto ſaid concerning the Diviſion of Trapezia's, the ſame is to be underſtood of the Geometrical Square, Parallelogram, Rhombus and Rhomboides.

PROBLEM XII. Fig. VII.

To divide an irregular Plan into two Parts (according to any poſſible Proportion given) by a Line drawn through a given Point within the ſame.

SUPPOSE the Plan $lnqsw$ be given, and let the Point z, where the Line mt cuts the Line op, be the given Point, and 'tis required to divide the Plan into two parts, that ſhall be to one another, as the Line a to the Line b. (1) Conſider thro' which Sides the Line of Partition mt muſt paſs, which here

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are the Sides *n q* and *s w*, and which continue until they meet in *x*. (2) Reduce the whole Plan into a Triangle, as before taught, and that Triangle into another, whofe Perpendicular is equal to a Perpendicular from *n*, upon the Line *r x*; from *n* let fall a Perpendicular on the Bafe *s x*, and on each Side thereof, on the Line *s x*, fet off the Segments of the Bafe on each Side the Perpendicular of the laft produced Triangle, which fuppofe to terminate in *y* and *r*. (3) Divide *y r* in *v*, fo that the part *y v* may be to the part *v r* as the Line *b* is to the Line *a*. (4) Take the neareft Diftance from the given Point *z* to the Bafe *r x*, and fay, As that Length is to the Length of the Perpendicular from *n* to the Line *r x*, fo is the Half of *x v* to *x w*, which fet from *x* to *w*. (5) From the Point *w* draw the Line *w o* parallel to *n x*; alfo from the given Point *z* the Line *o p* parallel to the Bafe *r x*, cutting each other in the Point *o*. (6) Take the Square of *z p* from the Square of *o z*, and the Side of a Square, equal to the Remainder, will be equal to *w t*, which fet from *w* to *t*. Laftly, Draw the Line *t z m*, which will divide the Plan into two parts, which are in Proportion to each other, as the Line *a* to the Line *b*, and the Line of Partition drawn thro' the given Point *z*, as required.

PROBLEM XIII. Fig. VII.

To cut from an irregular Plan given, a Part equal to a given Figure (whofe Area is lefs than the irregular Plan given) by a Right-line paffing thro' a Point given within the Plan.

SUPPOSE *l n q s*, &c. be the given Plan, and the Triangle *d g i* a Figure given, and *z* the given Point within the Plan. (1) Confider which Sides the Line of Partition, drawn through *z*, muft pafs, which here are the Sides *n q* and *s w*, which continue, until they meet in the Point *x*. (2) Reduce the given Triangle *d g i* into the Triangle *e g k*, whofe Perpendicular *k g* may be equal to a Perpendicular from *n* on the Bafe *s x*. (3) Find the Points *r*, *y*, as in the laft Problem, and fet *e g* (the Bafe of the Triangle *e g k*) from *y* to *v*, and fay as before; As the neareft Diftance, from the given Point *z* to the Bafe *s x*, is to the perpendicular Height of the Point *n* above the Bafe *s x*, fo is the half of *x v*, to *x w*. (4) From *w* draw the Line *w o*, and then proceed, as before in the laft Problem, and draw the Line *t z m*; then will the leffer part, next the Angle *q*, be equal to *d g i*, the Triangle given, as required.

PROBLEM XIV. Fig. VIII.

To divide a Trapezia, according to any Proportion given, by a Right-line drawn from a given Point without the Trapezia, and to lay the Part cut off towards any Place affigned.

SUPPOSE *o r s t* to be a given Trapezia, and let *v* be the given Point, from which is to be drawn a Right-line, as *v q*, that fhall divide the parts of the Trapezia, as the Line *a* is to the Line *b*, and to lay the leffer part next to *t*. (1) Since that the Line of Partition *v q* muft be drawn from the Point *v*, it muft pafs through the Sides *s t* and *o r*, which continue, until they meet in the Angle *m*; and, from the Point *v*, draw a Parallel to the Line *m t*, to meet *r m* continued in *n*. (2) Suppofe a Line be drawn from *r* to *s*, and, parallel thereto, another from *o* to the Bafe-line *m t*, cutting it in *w*; then is *w t*, the Bafe of the Triangle *w r t*, equal to the Trapezia *o r s t*. (3) Divide *t w* in *x*, fo that *t x* may be to *x w*, as the Line *b* is to the Line *a*. (4) Now fay, As *n v* is to *m x*, fo is *m r* to *m p*. (5) Find a mean Proportion between *n m* and *m p*, as *m k*, and bifect *m p* in *l*, and draw the Line *k l*; make *o q* equal to *k l*, and, from the Point *q* to the given Point *v*, draw the Right-line *q v*, which will divide the Trapezia, whofe parts will be to each other, as the Line *a* to the Line *b*, as was required.

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PROBLEM XV. Fig. VIII.

To cut from a Trapezia a Part equal to a Figure given, by a Line drawn from a given Point without, and to lay the Part cut off towards a Place appointed.

SUPPOSE *o r s t* be a given Trapezia, and *v* a given Point, from whence muſt be drawn a Line to cut off a part towards the Angle *t*, that ſhall be equal to the Parallelogram *c d h i*. (1) 'Tis evident, that the Line of Partition, from *v*, the given Point, muſt paſs through the Sides *s t* and *o r*; therefore continue thoſe Sides, until they meet in the Angle *m*. (2) From the given Point *v* draw the Right-line *v n* parallel to *m t*, until it meet *m r* continued in *n*. (3) Reduce the Parallelogram *c d h i* into the Triangle *c e h*, and that again into the Triangle *c f g*, whoſe Perpendicular *c f* may be equal to the Perpendicular from *r* upon the Baſe *m t*. (4) Make *t x* equal to *c g*, and then ſay, As *n v* is to *m x*, ſo is *m r* to *m p*. (5) Find the Point *g*, as in the laſt Problem, and draw the Line *q v*; then will the part *q t* be equal to the given Parallelogram, and be next to the Angle *t*, as required.

PROBLEM XVI. Fig. IX.

To divide a Plan given, according to any Proportion aſſigned, with a Line drawn from a given Angle, and to lay the Part required towards a Place appointed.

SUPPOSE the Plan *n i k c p* be given, to be divided into two Parts (as the Line *b*, is to the Line *a*) by a Right Line drawn from the Angle *k*, and to lay the leſſer Part next to *n*.

(1) Conſider on which Side the Line of Partition muſt fall, which in this Example will be *n p*, which continue both Ways towards *m* and *q* at pleaſure. (2) Reduce *n i k c p*, the Plan given, into a Triangle, as *k m q*, whoſe perpendicular Height above the Baſe *m q* be equal to the Height of *k* above *m q*. (3) Now becauſe the leſſer Part is to be laid next to *n*, therefore divide *m q* in *o*, ſo that *m o* may be to *o q* as the Line *b*, to the Line *a*; and then drawing the Line *k o*, the Plan will be divided as required.

PROBLEM XVII. Fig. X.

To divide a Trapezia into two Parts (according to any poſſible Proportion given) with a Line drawn through a given Point within the Trapezia.

SUPPOSE *i k n p* be a Trapezia given, and let *q* be a given Point, and 'tis required to divide the Trapezia into two Parts, in Proportion one to the other, as the Line *a* is to the Line *b*, by a Right Line drawn through the given Point *q*. (1) Conſider through which Sides the Line of Patition *s q r* muſt paſs, which in this Example are the Sides *i k* and *n p*, which continue to meet in *o*. (2) Find the Baſe of a Triangle equal to the given Trapezia, whoſe Perpendicular may be equal to the Perpendicular from *k* upon *o p*, as the Baſe *v p*, which divide in *w*, ſo that *v w* may be to *w p*, as the Line *a*, is to the Line *b*. (3) Through the Point *q* draw the Line *g l*, parallel to *o p*; and, taking the neareſt Diſtance from the Point *q* to the Baſe *o p*, ſay, As that neareſt Diſtance, is to the neareſt Diſtance from the Point *k*, to the Baſe *o p*; ſo is the half of *o w*, to *o m*, which ſet from *o* to *m*, and from *m* draw *m l* parallel to *o k*, cutting *g l* in *l*. (4) Take the Square of *h q*, from the Square of *q l* (which in the right-angled Triangle *d e f*, is *d e*, which ſet from *m* to *r*, and from the Point *r*, through the Point *q*, draw the Line of Partition *r q s*, which will divide the Trapezia into ſuch two Parts as required.

PRO-

PROBLEM XVIII. Fig. XI.

To divide a Plan according to any Proportion given, with a Line drawn from a Point aſſigned in any of the Sides, and to lay the Part required towards a Place appointed.

SUPPOSE *h i k l n g* be a Plan given, and *m* a Point aſſigned in the Side *ln*, from whence a Line is to be drawn, to divide the Plan into Parts in Proportion one to the other, as the Line *a* to the Line *b*, and to lay the greater Part next to *h*. (1) Conſider to which Side the Line of Partition muſt be drawn, which in this Example is *h g*, which increaſe both Ways towards *r* and *s*. (2) Find *s r*, equal to the Baſe of a Triangle, equal to the given Plan, whoſe Perpendicular is the neareſt Diſtance from the Point *m*, on that Baſe. (3) Divide that Baſe in *p*, as the Line *a* to the Line *b*; and becauſe the greateſt part muſt be laid towards *h*, therefore ſet the greater Segment of the Baſe from *r* to *p*, and draw the Line *m p*, which will divide the Plan as required.

PROBLEM XIX. Fig. XII.

To divide a Plan according to any Proportion aſſigned between two Sides, with a Parallel to a Line given, and to lay the Part required towards a place appointed.

SUPPOSE the Plan *hg c d f n i* be given to be divided into two parts, in proportion one to the other, as the Line *o*, to the line *p*, with a Parallel to the Line *a b*, and to lay the leſſer part next to *n*. (1) Conſider through which Sides the Line of Partition muſt paſs, which in this Example are the Sides *i n* and *d f*, which continue until they meet in *x*. (2) Find *q x*, the Baſe of a Triangle, equal to the given Plan, whoſe Perpendicular is equal to the neareſt Diſtance from the Point *d*, to the Baſe *i n*. (3) Divide that Baſe *q x* in *m*, ſo that *z m* be to *m q*, as the Line *p* to the line *o*; and ſet the leſſer Segment, from *q* to *m*, next to *n* (becauſe it is ſo required). (4) From the Point *d* draw the Line *d k*, parallel to the given Line *a b*, to cut the Baſe *i n* in *k*. (5) Find a mean Proportion between *x m*, and *x k*, which is *x l*. (6) From the Point *l* draw the Line *l e* parallel to *k d*, which will divide the given Plan into two parts with the leſſer next to *n*, as required.

PROBLEM XX. Fig. XIII.

A Triangle as h i e being given with the Triangle o m e adjoining to it, whoſe Side e m is ſuppoſed to be continued out at pleaſure towards l, to find a Point in the Side h c, as g, from whence a Parallel drawn to h i, as g k, and another to o m, as g n, in ſuch ſort, that the Part k i h g cut off, may be equal to the Part g n o m taken in; that is, that the Trapezia k g n e may be equal to the two Triangles h i e, and o m e, taken together.

(1) FIND a mean Proportional between *h e*, and a Perpendicular on *h e* from the Angle *i*, as *b c*; alſo a mean Proportional between *o e*, and a Perpendicular on *o e*, from the Angle *m*, as *a c*. (2) Add the Squares of theſe mean Proportionals into one Square, whoſe Side is *b a*; divide the Side *h e* in Power, as *e o*, to its Perpendicular from *m*; ſo that, as the Perpendicular from *m*, upon his Baſe *o e*, is to *o e*, ſo is the leſſer Part of the Power of *h e*, to the Power of *h e*, being ſo divided; which leſſer Part in Power is the Line *c d*, whoſe Square being added to the Square of *b c*, their Sum is equal to a Square, whoſe Side is *b d*. (3) If *b d* give *b a*, what will *h e* (which is equal to *b f*)? Anſwer, *b z*; which take and ſet, from *e* to *g*, upon the Side *h e*. (4) From the Point *g* draw *g k* parallel to *h i*, and *g n* parallel to *o m*; then will the Trape-

zia

zia *h i k g* cut off, be equal to the Trapezia *g n o m* taken in; and consequently the Trapezia *k g n e* will be equal to the Triangle *h i e*, and the Triangle *o m e*, as required.

PROBLEM XXI. Fig. XIV.

There is a given Plan, as d b c h l, and in the Side h n is a Point, as c, from whence 'tis required to draw a Line, as c f, to cut off two Triangles b d c, and h g f, and to take in the Triangle d e g equal to them both. So that the Trapezia c n f l may be equal to the given Plan d b c h l.

(1) REDUCE the given Plan into the Triangle *a n l* equal thereto; and from the given Point *c* draw the Line *c f*, so as to make the Triangle *k f l* equal to the Triangle *a c k*, then will the Triangle *d e g* taken in, be equal to the two Triangles *b c d*, and *h g f* left out, and consequently the Trapezia *c f n l* will be equal to the given Plan required.

Plate CCCCLX. *The Division of Geometrical Figures, by* VINCENT WING, *with Decimal Arithmetick lineally demonstrated.*

PROBLEM I. Fig. I.

To divide a Right-line (as c) given into two such parts, that shall have such Proportion, as the Line b to the Line a.

(1) MAKE an Angle as *f d g* at pleasure; make *d g* equal to the given Line *c*, also *d e* equal to the Line *a*, and *e f* to the Line *b*. (2) Join *f g*, and from the Point *e* draw the Line *e h* parallel to *f g*, cutting *d g* in *h*; then as *d e* is to *e f*, so is *d h* to *h g*, which are the Parts divided as required.

PROBLEM II. Fig. II.

To divide a Right line (as d f) in Power, according to any Proportion given: Suppose as the Line a is to the Line b.

(1) DIVIDE the given Line *d f* in *e*, so that the lesser Segment *d e* may be to the greater *e f*, as the Line *a* is to the Line *b*. (2) Bisect *d f* and on it describe the Semicircle *d c f*, and from the Point *e* raise the Perpendicular *e c*; also draw the Lines *d c*, *c f*, which two Lines together are equal in Power to the given Line, and the Power of *c f*, is in such Proportion to the Power of *c d*, as the Line *b*, to the Line *a*, which was required.

PROBLEM III. Fig. III.

To divide any Triangle given (as c d f) according to any Proportion required (as the Line a, is to the Line b) by a Line drawn from d, an Angle assigned.

DIVIDE the Base *c f* in *e*, so that *c e* may be to *e f*, as the Line *a*, is to the Line *b*, and then drawing the Line *d e*, the Triangle is divided as required.

PROBLEM IV. Fig. IV.

From a given Triangle as m h k, to cut off any part, by a Line drawn, from either of its Angles.

SUPPOSE the Area of the Triangle be equal to 372 Poles three 4ths, and the Side *d f*, 42, and 'tis required to cut off 90 Poles with a Line proceeding from the Angle *d*. To perform this, say, If 372 three 4ths, the Area of the

the whole Triangle, give 42 for its Baſe, how much of that Baſe, in the ſame Parallel, will 90 require? Anſwer, $10\frac{14}{100}$; for as 372 three 4ths is to 42, ſo is 90 to $10\frac{14}{100}$, which ſet from *k* towards *m*, as to *l*, and draw the Line *h l*; then will the Triangle *h l k* be equal to 90 Poles, as required.

PROBLEM V. Fig. V.

To divide a Triangle, according to any Proportion given, by a Line drawn parallel to any of the Sides aſſigned.

SUPPOSE *a g f* be a Triangle given, and 'tis required to cut off three 5ths by a Line parallel to *a g*. (1) On the Line *a f* deſcribe the Semicircle *a h f*, and divide *a f* into five equal parts, according to the greater Term. (2) On *c*, which is the third part from *f*, let fall the Perpendicular *c h*, and draw the Lines *h f*; make *f b* equal to *f h*, and from the Point *b* draw a Right-line parallel to *a g*, as *b i*; then will the Triangle *b i f* contain three 5ths of the Triangle *a g f*, as required.

PROBLEM VI. Fig. IV.

To divide a geometrical Square, (as a d g f) according to any Proportion aſſigned, by a Line drawn parallel to one of its Sides.

SUPPOSE the Square contain 676 ſquare Poles, and 'tis required to cut off 208 by the Line *b c*. (1) Find the Side of the given Square, which here is 26, and then ſay, If 676 requires a Length of 26, what doth 208 require? Anſwer, 8; for, as 676 is to 26, ſo is 208 to 8; therefore ſet 8 from *a* to *b*, and from *d* to *c*, and draw *b c*; then will the Parallelogram *a b d c* be equal to 208 Poles, as required.

PROBLEM VII. Fig. V.

From an irregular Plan (as p m i k n l q) to cut off any parts required.

'TIS required to cut off 420 ſquare Feet by a Line drawn from the Angle *l* to cut the oppoſite Side. (1) Meaſure the Area of the Trapezia *m l p q*, which contains 324 Feet; alſo meaſure the Area of the Triangle *i l m*, whoſe Area 135, added to the former, is equal to 459, which being 39 Feet more than the part to be cut off, therefore, from the Triangle *i l m*, cut off 39 Feet, according to the 4th Problem hereof, which is the Triangle *i l n*, and the Remainder *n m l*, with the Trapezia *m l p q*, is the parts cut off, as required.

Note, This and the following Problem will be better underſtood, when *The Menſuration of ſuperficial Figures*, &c. is learned, which will be compriſed in VOL. II.

PROBLEM VIII. Fig. V.

To divide a given irregular Plan into any equal parts required.

SUPPOSE *s o t v w* be given to be divided into two equal parts, the Area of the Whole being 705 ſquare Feet, whoſe half is 352, 1 half. (1) Meaſure the Triangle *a s w*, and its Area will be found to be 290, which taken from 352, 1 half, the Remainder is 62, 1 half. (2) Take 62, 1 half from the Triangle *o t w*, which is the Triangle *o r w*, which with the Triangle *o s w* is one half of the Whole, as required.

BY the ſame Rule any geometrical Figure, be it ever ſo irregular, may be divided into as many parts, and of any Quantity, at pleaſure.

As I have now finiſhed theſe geometrical Problems, which afford a great Variety of Practice and Pleaſure to ſuch as delight in this *Science*, as well as of very great Uſe in ſetting out, and dividing of Lands, that are intricate, and which very often happens in Practice, I ſhall now proceed to demonſtrate the Nature of Decimal Arithmetick, and afterwards the Geometrical Conſtruction of the Alphabet, with which I ſhall cloſe this firſt Volume of this moſt extenſive and laborious Undertaking.

DECIMAL ARITHMETICK *demonſtrated.*

I. NUMERATION *of Decimals.*

This Kind of Arithmetick ſuppoſes the Integer to be always divided into ten equal parts, and ſometimes each of thoſe parts are ſuppoſed to be ſubdivided again into ten equal parts alſo, which thereby divide the Integer into 100 parts. Suppoſe the Line *a l*, Fig. VI. be an Integer, divided into 10 equal parts at the Points *b*, *c*, *d*, *e*, *f*, *g*, *h*, *i*, *k*, then *a b* is one 10th, *a c* two 10ths, *a d* three 10ths, *&c.* of the whole Line *a l*; but if each of theſe 10th parts is divided, or ſuppoſed to be divided, into 10 equal parts alſo, as *m n*, which is one 10th of *m x*, then *m x* is thereby divided into one hundred parts, and *m n*, which is equal to one 10th of *a l*, doth now repreſent ten of the 100 parts, into which the Integer *m x* is divided, and is thus expreſſed, $\frac{10}{100}$. In like manner *m o* is $\frac{20}{100}$, *m p* $\frac{30}{100}$, *m q* $\frac{40}{100}$, *m r* $\frac{50}{100}$, &c. The Subdiviſions of theſe 10ths are expreſſed according to their Places, that is, the firſt 10th part of *m n* ſignifies $\frac{1}{100}$, the firſt and ſecond parts $\frac{2}{100}$, the firſt, ſecond and third $\frac{3}{100}$; and ſo in like manner all the others. If each of theſe 100 parts are again ſubdivided into 10 equal parts, then the Integer will be divided into 1000 parts, and *m n*, which before repreſented $\frac{10}{100}$, will now repreſent $\frac{100}{1000}$, alſo *m o* $\frac{200}{1000}$, *m p* ,, &c.

Now, if we place $\frac{1}{10}$, $\frac{10}{100}$, $\frac{100}{1000}$ thus, 'tis evident, that $\frac{100}{1000}$ is but one 10th of the Whole, as alſo is $\frac{10}{100}$ the ſame; for one 10th of 1000 is 100, and one tenth of 100 is 10; and therefore, if the hundredth part of one Integer be equal to another Integer divided into 1000 parts, then $\frac{10}{100}$ of the firſt is equal to $\frac{100}{1000}$ of the laſt, and each but one 10th of the Integers. Now from this 'tis plain, that the Addition of Cyphers doth not encreaſe the Quantity of the Fraction; for $\frac{1|000}{10|000}$, $\frac{2|000}{10|000}$, $\frac{3|000}{10|000}$ are no more, than $\frac{1}{10}$, $\frac{2}{10}$, $\frac{3}{10}$, as is evident, if from each Fraction you cut off towards the Right-hand the laſt three Cyphers, when the Remainders to the Left will be $\frac{1}{10}$, $\frac{2}{10}$, $\frac{3}{10}$, as aforeſaid. As the Denominator of a Decimal Fraction is here ſhewn to be an Integer divided into 10, 100, 1000, &c. equal parts, it is never written in Practice, but always underſtood to conſiſt of as many Cyphers following the Unit, as are Figures and Cyphers in the Numerator; ſo $\frac{1}{10}$ is expreſſed by the Figure 1, with a Comma before it, thus ,1; and $\frac{1}{100}$ thus ,01; ſo likewiſe $\frac{2}{10}$ is expreſſed thus ,2; and $\frac{26}{100}$ thus ,26; alſo $\frac{26}{1000}$ thus ,026.

Now, by the preceding it appears, that the prefixing of Cyphers to the Numerator of a Fraction doth diminiſh it ten times; for in the aforeſaid Fraction of $\frac{1}{10}$, which is ſignified thus ,1, and ſignifies one tenth, by having a Cypher prefix'd to it, as thus ,01, doth now ſignify but one hundredth part; and if to it two Cyphers had been prefix'd, as thus ,001, it would then have ſignified but one thouſandth part, becauſe (as I ſaid before) the Denominator muſt be underſtood to contain as many Cyphers following the Unit, as are Cyphers and Figures contained in the Numerator.

II. ADDITION *of Decimals.*

The *Addition* of *Decimals* is the ſame, as of whole Numbers in Vulgar Arithmetick, carrying one for every ten, as is evident by the following Example.

EXAM-

EXAMPLE I. Fig. VIII.

Add together the Lines $\left\{\begin{array}{l} a\,b \text{ equal to } 1,4 \\ c\,d \text{ equal to } 2,5 \\ e\,f \text{ equal to } 1,7 \\ g\,h \text{ equal to } 2,9 \end{array}\right\}$ which is equal to the Line *i k*, becauſe *n k* is equal to *a b*, *m n* to *c d*, *l m* to *e f*, and *i l* to *g h*.

and their Sum is 8,5

In Fig. VII. the Line $\left\{\begin{array}{l} a\,b \\ c\,d \\ e\,f \end{array}\right\}$ equal to $\left\{\begin{array}{r} 1,9 \\ 3,3 \\ 4,8 \end{array}\right.$

their Sum is 10,0

III. SUBTRACTION *of Decimals.*

THE *Subtraction* of *Decimals* is the ſame, as of *whole Numbers.*

EXAMPLE I. Fig. IX.

From the Line *a b*, equal to 4,7
Take the Line *c d*, equal to 2,9

Remains the Line *e f*, equal to 1,8

EXAMPLE II. Fig. X.

From the Line *a b*, equal to 3,9
Take the Line *c d*, equal to 2,3

Remains the Line *e f*, equal to 1,6

IV. MULTIPLICATION *of Decimals.*

MULTIPLICATION of *Decimals* may be performed, either as whole Numbers in Vulgar Arithmetick, and from the Product cut off as many Figures towards the Right-hand, as are Figures in the two Fractions; or in the ſame Manner as Duodecimal Multiplication, but with this Difference, that whereas therein the Products of the Feet multiplied into the Inches are divided by 12, the Number of Inches in a Foot; ſo here the Product of the Integers, multiplied into the decimal parts, muſt be divided by 10, 100, &c. the parts, into which the Integer is divided.

EXAMPLE I. *According to whole Numbers in Vulgar Arithmetick.*

Multiply 9,6
By 5,4

384
480

Product 51|84 From which cut off the two Figures 8 4 towards the Right-hand, becauſe there are two Figures in the two Fractions of the Multiplicand and Multiplier, *viz.* ,6 and ,4, and the Product is 51,84.

9·6
5·4
45·0
3·0
2·0
50·8

EXAMPLE II. *According to Croſs Multiplication.*

Multiply 9,6
By 5,4

45
3,0
3,6
2,4

51,84

(1) Mul-

(1) Multiply 5 Feet into 9 Feet equal to 45 Feet, which are the great Squares in Fig. IX. (2) Multiply 5 Feet into 6 tenths, which are the Parallelograms *s*, *s*, &c. equal to 30 tenths, or 3 Integers. (3) Multiply 9 Feet into 4 tenths, which are the Parallelograms *r*, *r*, *r*, &c. equal to 36, or 3 times 10 equal to 3 Integers and 6 parts, which set down, as above, under Feet and parts. (4) Multiply the parts 4 into 6, (which is the Parallelogram *b f n g*) and the Product is 24, equal to 2 parts and 4 seconds, which place under parts and seconds, as in the Example. (5) Add together the Whole, carrying 1 for every 10, and the Sum 51,84 is the Product required, and which is the same, as that above produced by common Multiplication, in Example I. But it is here to be observed, That altho' this kind of Multiplication may be performed as by Example I. yet, as that Way or Method doth not demonstrate how the Produce arises, which is done by this last Method, I must therefore (without regard to its being my own Invention) recommend it before the other, as being wholly demonstrative, and equally as easy as the former.

As the Dimensions of the several Works in Buildings are measured either by Feet and Inches, or Feet and decimal parts of a Foot, and are squared according to the preceding Rules in duodecimal or decimal Multiplication; and as my Design herein is only to exemplify those Rules, for the well understanding of Mensuration, when we come to that part, I shall not proceed to *Division, &c. of Decimals*, which is common in almost every Author of Arithmetical Tracts, and of very little, or no Use in Mensuration, when known.

Plates CCCCLXI. CCCCLXII. CCCCLXIII. CCCCLXIV. *The geometrical Construction of the Twenty-four Letters of the Alphabet, by Mr.* ROBERT WEST.

PERHAPS it may be thought, that to teach the Horn-book at the Conclusion of *Geometry* may be absurd and needless; but if we consider the great Difficulty that Workmen are put to, to proportion Letters of Inscriptions, *&c.* that stand much above the Level of the Eye, it will appear to be a useful Instruction. The Methods hitherto practised have been to make them either at a Venture, or by Trials of Letters of divers Magnitudes first made, and then placed up against the Building, where the Inscription, *&c.* is required, which they have either increased or decreased in Magnitude, as their Judgment directed them. An Instance of which was done, for to find the Height and Proportion of the Letters of his Majesty's Name and Date of the Year against the Frontispiece to the *Meuse-Stables* at *Charing-Cross*, and (if I mistake not) by the Direction of the Board of Works, or at least of their Surveyor and Comptroller, who, 'tis reasonable to believe, knew not how to effect them otherwise: I say, if this, and such like Instances be considered, (of which I could enumerate many, to the eternal Shame of those who have most stupidly undertaken the Direction of Works) it must be allowed, that to teach them their Horn-book by geometrical Rules, how at once to make those Letters proportionable to any Height, will be doing them, and such part of the Publick, as may be desirous to know their Constructions, a Service worthy of Thanks; to which I proceed.

I. *Of the Letter* A, Plate CCCCLXI.

(1) MAKE a geometrical Square, of Diameter equal to the given Height of the Letter, as *a d r* A, and draw the Diameters *c t* and *f g*; draw *c r*; make *c z* equal to *c t*, and from *z* draw *z s* perpendicular to *r* A; also from *z* draw *z y* parallel to *r* A, then is 13 *r* the Thickness of the full Stroke, 13 *y* the Thickness of the fine Stroke of every Letter, and *y r* the Projection of each Grace

to

to every Letter, whether right or oblique-angled. *The Height of each Grace* is equal to the fine Stroke, and which is neceſſary to be ſo, when Letters are much elevated above the Eye; therefore draw the Line *h i* parallel to the Baſe *r* A. Now to form the Letter draw *c s*; make *t v* equal to *s t* and *c v*; draw 11 *w* at the parallel Diſtance of 13 *r*, alſo 11 *p* parallel to *c s*, at the Diſtance of the fine Stroke 13 *y*; make the croſs Stroke 12 equal in Thickneſs to the fine Stroke, and wholly below the Diameter *f g*; and thus is the Letter form'd, the Graces only excepted, which are thus perform'd.

THE Projection of the Grace to every Letter, as aforeſaid, is equal to the Line *y r*; therefore make *q h*, *q n*, *p o*, *p m*, 10 8, 10 7, 5 1, 5 4, each equal to *y r*, and from thoſe ſeveral Points raiſe Perpendiculars, as *h k*, *n k*, *o l*, *m l*, 8 6, 7 6, and 4 3, 1 3, interſecting in the Points *k*, *l*, 6, 3, which are the Centers to the Curves of thoſe Graces.

II. *Of the Letter* B.

DELINEATE the broad Stroke with the Thickneſs and Projections of its Graces at Top and Bottom, as in the laſt, which is always to be obſerved in every Letter. The Curvature of each Grace here is deſcribed on the Interſections of the Perpendiculars *e k* and *k l*; and ſo in like manner that at Bottom. Biſect *a c* in *m*, and draw *m n* parallel to the Baſe; make *m o* equal to the fine Stroke, and draw *o p* parallel to *m n*; on *a*, with the Radius *n o*, deſcribe the Arch *o q*, and on *b*, with the Radius *b r*, deſcribe the Arch *r s*; from *q* and *s* draw *q v* and *s t* perpendicular to the Baſe, which biſect by a Right-line, as *w x*; make *x y* equal to *x s*, alſo *z* 1 equal to *z* 2; on the Point 1, with the Radius 1 *z*, deſcribe the Arch 3 *z* 4, and on the Point *y*, with the Radius *y x*, deſcribe the Arch 5 *x* 6, which completes the upper part; the under part is made by the ſame Rule, as Inſpection ſhews.

III. *Of the Letter* C.

DESCRIBE a geometrical Square, as *a b c d*, equal to the Height of the Letter, and draw the Diameter *e f g h*, and the Diagonals *a d*, *b c*; on the Center *i*, with the Radius *i e*, deſcribe the Circle *e h f g*; make *g k*, *i l*, *i m*, *i n*, *i o*, and *n p*, each equal to the Thickneſs of the full Stroke; through the Point *q* draw *r s* parallel to the Side *b d*, which terminates the Top of the Letter; with the Radius *p k*, on *p*, deſcribe the Arch *t k v*; biſect the Arch *w e* in *y*, alſo *e q* in *z*, alſo *x f* in 1, and draw Lines from the Points *y z* and 1 to the Center *i*; on the Point *n*, with the Radius *n t*, deſcribe the Arches *t* 2 and *v* 3; on the Point *m*, with the Radius *m* 2, deſcribe the Arch 2 4, and on *o* the Arch 3 5; on the Point *m*, with the Radius *m* 5, deſcribe the Arch 5 6; on the Point *l*, with the Radius *l* 4, deſcribe the Arch 4 *s*; draw *h q* continued to cut *a b* in 7; on the Point *q*, with the Radius *q* 8, deſcribe the Arch 8 9, and from the Point 9 draw the Line 9 *i*; on the Point 9, with the Radius 9 10, deſcribe the Arch 10 *r*, which completes the Letter.

IV. *Of the Letter* D.

MAKE the full Stroke and its Graces, as Letter B; biſect its Height by the Line *a b*, alſo biſect *a c* in *d*; on *e* deſcribe the Arch *d f*, and on *g* the Arch *h i*; from the Points *i* and *f* draw the Lines *i k* and *f l* parallel to the full Stroke; make *b n* equal to *b l*, and *m p* equal to *m o*; on the Point *n*, with the Radius *b l*, deſcribe the Arch *q b r*, and on the Point *p*, with the Radius *m o*, the Arch *s m t*, which completes the Letter.

V. *Of the Letter* E.

MAKE the full Stroke with its fine Strokes and Graces, as before; biſect the Height by the Line *a b* parallel to the Baſe; make *c d* and *f g* equal to *f e*, and draw *f d*, which terminates the Extreams of the Letter; make *i h* and *k l*, the Depth of the Graces, equal to the Breadth of the full Stroke, and turn their Curves as before; draw *g c* cutting *a b* in *m*, through which Point draw *n o* parallel to the full Stroke; the Thickneſs of the Tongue is equal to the fine Stroke, placed equally above and below the Line *a b*; the Graces are of the ſame Dimenſions, as thoſe of the Top and Bottom of the Letter.

VI. *Of the Letter* F.

THIS Letter is the ſame as Letter E, the Bottom excepted, which hath its Graces as before.

VII. *Of the Letter* G, Plate CCCCLXII.

THE upper part of this Letter, *a b c d e*, is the ſame as Letter C, and the Remainder is thus deſcribed: The Diagonal *f g*, and the Perpendicular *b h* being drawn, make *i k* equal to the full Stroke; from *l* draw *l m* parallel to the Baſe, and *n o*, the Thickneſs of the fine Stroke, parallel to the former; then deſcribe the Graces as in Letter B; with the Radius *l p*, on *l*, deſcribe the Arch *p q*, which compleats the Letter.

VIII. *Of the Letter* H.

THE Diſtance of the inward Lines *a b* of the two full Strokes are equal to half the Height of the Letter, as *c d*; the croſs Bar equal to the fine Stroke, ſet equally above and below the middle Line *d e*, and the Graces as in Letter B.

IX. *Of the Letter* I.

THIS Letter is only the full Stroke with its Graces, as the Letter B.

X. *Of the Letter* K.

THE firſt part is the ſame as the preceding Letter I, whoſe Height is biſected in *c*; make *a d* equal to *a c*, and draw the Line *c d*, and make *e f* parallel thereto, at the Diſtance of the fine Stroke; make *b g* equal to *b c*, and draw the Line *c g*; make *h i* parallel to *c g*, at the Diſtance of the full Stroke; ſet off the Graces from *k l* and *m n*, and compleat their Curves, as in the oblique Graces in Letter A.

XI. *Of the Letter* L.

MAKE the full Stroke as the Letter I, and the Projection of its Bottom equal to half its Height, with its Grace the ſame as Letter E.

XII. *Of the Letter* M.

MAKE a geometrical Square, as *a b c d*, equal to the Height, draw the fine Stroke *a e c f* on the Left, and the full Stroke *g b h d* on the Right; biſect

f h

f h in *i*, and draw the Line *m i*, and make *n o* parallel to *m i*, at the Diſtance of the full Stroke; draw *l i*, and *g o* parallel thereto, at the Diſtance of the ſmall Stroke, and making the Graces as the Letter B, the Whole is compleated.

XIII. *Of the Letter* N, Plate CCCCLXIII.

DIVIDE the Perpendicular *a b* into 4 equal parts; make *b f* equal to *b c*, and draw *f g* parallel to *a b*; make *a l b k* and *h g i f* each equal to the fine Stroke, and draw the Lines *l k* and *h i*; draw the Line *m f*, and parallel thereto the Line *n o*, at the Diſtance of the full Stroke, and then, making the Graces as the Letter B, the Whole is done.

XIV. *Of the Letter* O.

TO form this Letter, make the firſt part of the Letter C right and reverſed.

XV. *Of the Letter* P.

MAKE the full Stroke with its Graces, as in Letter B; biſect its Height in *b*, and draw *b c* parallel to its Baſe; ſet the Breadth of the fine Stroke equally above and below the Line *b c*; make *a d* equal to *a e*, and *f h* equal to *f g*, and draw the Perpendiculars *h c* and *d i*; biſect *h c* in *k*, and draw the Line *k l* parallel to the Baſe; make *k m* equal to *h k*, and *p n* equal to *p o*; on the Point *m*, with the Radius *m k*, deſcribe the Arch *q k r*, and on *n*, with the Radius *n p*, deſcribe the Arch *s p t*, which compleats the Whole.

XVI. *Of the Letter* Q.

FIRST make the Letter O, as before directed; biſect *a b* in *c*, and draw the Line *c d*; biſect the Arch *d c* in *f*, and draw *f* to the Center *g*; on the Point *d*, with the Radius *d i*, deſcribe the Arch *h k*, and on the Point *c*, with the Radius *c k*, deſcribe the Arch *k l*; with the Radius *h m*, on the Point *h*, deſcribe the Arch *m n*, and on *n* deſcribe the Arch *h n*, interſecting *m n* in *n*; on the Point *n*, with the Radius *n h*, deſcribe the Arch *h m*; on the Point *o*, (found before) with the Radius *o m*, deſcribe the Arch *m l*, which compleats the Whole.

XVII. *Of the Letter* R.

MAKE the Top and left Side as the Letter P; biſect *a b* in *c*, and draw *c d* parallel to the Baſe; from the Points *e g* (found before) draw *e f* and *g h* perpendicular to the Baſe, cutting *c d* in *f* and *h*; on *h*, with the Radius *g i*, deſcribe the Arch *l k*, and on *f*, with the Radius *e m*, deſcribe the Arch *n o*; make *o p* equal to *h k*, and *k d* equal to *f o*; on the Point *p*, with the Radius *p o*, deſcribe the Arch *o q*, and on *d*, with the Radius *k d*, deſcribe the Arch *k q*, which compleats the Whole.

XVIII. *Of the Letter* S.

DRAW a geometrical Square, as *a b c d*, with its Diagonals *a b* and *d c*, alſo the Diameter *e f*; make *g h* equal to the fine Stroke, and *h i* equal to the full Stroke; make *e k* and *l f* each equal to the fine Stroke; biſect *e h* in *m*, and *k i* in *n*; on *m*, with the Radius *m e*, deſcribe the Arch *p e h*, and on *n*, with the Radius *n k*, the Arch *k q i*; on *m*, with the Radius *m k*, deſcribe the Arch

k r;

k r; draw the Line *r s* from the Point *r* perpendicular to the Baſe, and draw *k t* parallel to the Baſe; draw the Line *s m*, and on *v*, with the Radius *v w*, deſcribe the Arch *w t*, which finiſhes the upper part. Biſect *i f* in *x*, and *h l* in *y*; on *x*, with the Radius *x i*, deſcribe the Arch *i f z*; on *y*, with the Radius *y h*, deſcribe the Arch *h* 1 *l*; on *x*, with the Radius *x l*, deſcribe the Arch *l* 2; from the Point 2 draw the Line 2 3 perpendicular to the Baſe, draw 3 *x* and *l* 4, then on the Point 5, with the Radius 5 6, deſcribe the Arch 6 ~, which compleats the Whole.

XIX. *Of the Letter* T, Plate CCCCLXIV.

COMPLEAT a geometrical Square, as *a b c d*; draw the Diameter *e f*, and ſet the Breadth of the full Stroke equally on each Side, and draw the Lines *g h* and *i k*; make *l m* parallel to *a b*, at the Diſtance of the fine Stroke; make the Graces of the Top as in Letter E, and thoſe at Bottom as Letter B.

XX. *Of the Conſonant Letter* V.

THIS Letter is no more, than the Letter A inverted, without the croſs Bar.

XXI. *Of the Vowel* U.

MAKE the full Stroke *a b c d*, and divide *a c* into 4 equal parts; make *a h* equal to *a g*, and draw the Line *h i* perpendicular to the Baſe; draw *k l* parallel to *h i*, at the Diſtance of the fine Stroke; biſect *c i* in *m*, and on *m*, with the Radius *m c*, deſcribe the Arch *c n i*; through the Point *n* draw *o p* parallel to the Baſe; on *n*, with the Radius *n o*, deſcribe the Arch *o m p*; biſect *d l* in *q*, and draw *q r* perpendicular to the Baſe; on *r*, with the Radius *r s*, deſcribe the Arch *s v t*, and then, compleating the Graces, the Whole is done.

XXII. *Of the Letter* W.

MAKE the Conſonant V, as *d b a*; biſect *a b* in *c*; make another Conſonant V, whoſe firſt Line *e f* ſhall interſect the Line *a b* in *c*, which compleats the Whole.

XXIII. *Of the Letter* X.

COMPLEAT a geometrical Square, as *a b c d*, and draw the Diameters *e f* and *g h*, draw alſo the Diagonals *g e* and *e h* of the little Squares *a e i g* and *e b i h*; on *e*, with the Radius *e k*, deſcribe the Arch *l m n*; draw *l o* and *n p* both perpendicular to the Baſe; draw *l p* and *n o*, which are the central Lines of the Strokes of the Letter; ſet the full Stroke equally on each Side the Line *l p*, and draw the Lines *q r* and *s t*; ſet the fine Stroke equally on each Side the Line *n o*, and draw the Lines *v w* and *x y*, which, with the Graces compleated as in Letter A, compleats the Whole.

XXIV. *Of the Letter* Y.

MAKE a geometrical Square, as *a b c d*, and draw the Diameters *e, f, g, h*; on *e*, with the Radius *e h*, deſcribe the Arch *h i g*; biſect *e i* in *k*; on *e*, with the Radius *e k*, deſcribe the Arch *o k p*; draw the Line *i n*, touching the Arch in the Point *m*, and *i q* touching the Arch in the Point *l*; make *r s* parallel to *n i*, at the Diſtance of the full Stroke, and *s p* parallel to *q i*, at the Diſtance of the fine Stroke; ſet the Breadth of the full Stroke equally on each Side the central Line *e f*, as *t v*, and draw the Lines *w t* and *x v*; make the upper Graces as in Letter A, and thoſe at Bottom as Letter B.

XXV.

XXV. *Of the Letter* Z, Plates CCCCLXV. CCCCLXVI.

COMPLETE a geometical Square, as *a, b, c, d,* and make the Top and Bottom Strokes equal to the fine Stroke; let the Fulneſs of the full Stroke, from *b* to *e*, and *c* to *f*, and draw the Lines *e c*, and *b f*; then completing the Graces, as in Letter E, the *Horn-book* is completed as required.

Plates CCCCLXV. CCCCLXVI. *Of the Geometrical Conſtructions of Hour - Figures for Clocks and Sun-dials, by Mr.* ROBERT WEST.

THE uppermoſt Figure of this Plate contains three Examples of Hour-Circles for Clock-Dials: The firſt is the Manner of proportioning and dividing the Marginal Circle into twenty four Hours, with a Circle of ſixty Minutes on its Limb, as follows.

I. *To proportion the Breadth of the Margins.*

(1) THE Diameter *a n* being given, divide the Radius *a m* into four equal Parts, of which the outermoſt (*a f*) is the Breadth of the Margin. (2) Subdivide *a f* into four equal Parts, of which the outermoſt (*a b*) is the Breadth of the Minute Circle. (3) Divide *d f* into two equal Parts in *e*, then is *e f* the Breadth of the Circle for the Quarters of the Hours, and the remaining Part *b e* is the Circle for the Capital Figures. The Thickneſs of the Diviſional Lines of the Circles *a b* and *e f* are each equal to one 4th of *e f*, to be ſet off from *a* towards *b*, and from *b* towards *a*; alſo *e* towards *f*, and from *f* towards *e*. (4) On the Point *m*, with the Radius *m a*, *m b*, *m e*, and *m f*, deſcribe the Circles *a b*, *e f*, with their Thickneſſes, as aforeſaid.

II. *To divide the Hours and Minutes.*

(1) FROM the Point *f* divide the Circle *f* into twenty four equal Parts, and from the Center *m* draw Right lines through each of the twenty four Points, continued through the Marginal Circle *b e*, which are the central Lines of each Figure. (2) Subdivide each of the twenty four equal Parts in the Circle *e*, into four equal Parts, for the Quarters of each Hour, and make the Diviſionary Strokes in Thickneſs equal to the circular Lines. (3) Divide the outer Circle *a* into twelve equal Parts, which are the Places for 5, 10, 15, 20, *&c.* Minutes, and which being each ſubdivided into 5 equal Parts, gives 60 Minutes in the whole.

THE ſecond Example is the Manner of dividing a Circle of 12 Hours without Minutes, as follows.

I. *To proportion the Breadth of the Margin.*

THE Diameter *f o* being given, divide the Radius *f m* into three equal Parts, and *f h*, the outer Part, will be the Breadth of the Margin: Divide *f h* into eight equal Parts, and *g h*, the innermoſt, is the Breadth of the Circle for the Quarters, and the Breadth of the circular Lines is one 4th of *g h*, to be ſet off from *h* towards *g*, from *g* towards *h*, and from *f* towards *g*.

II. *To divide the Hours.*

DIVIDE the Circle *f* into twelve Parts, and draw Lines to the Center *m*, which are the central Lines of the Figures; and then ſubdividing each Part into four equal Parts, completes all the Diviſions required.

THE third Example is the Manner of dividing a Circle of twelve Hours, with a Circle of 60 Minutes on its Limb, as follows.

I. *To proportion the Breadth of the Margins,* &c.

(1) THE Diameter *h p* being given, biſect the Radius *h m* in *l*; make *h i* equal to one 4th of *h l*, and *k l* equal to 1 half *h i*; then the Remainder *i k* is the Margin for the Hour Figures, *k l* for the Quarters, and *h i* for the Minutes. (2) Set off the Breadth of each circular Line, and divide the Quarters and Minutes, as in the firſt Example.

N. B. The Diſtance between the Extreams of each Figure, and the circular Lines of their Margins, in every Example, muſt be equal to the Thickneſs of thoſe circular Lines.

THE Letters that expreſs the Hours, are the Capitals I, V, and X, which are thus formed; (1) The Letter I, hath its Breadth equal to one 8th of its Height, and the Projection of its Graces equal to one half of its Breadth. (2) To form the Letter V, divide its Height into eight equal Parts, and draw the central Line *c d*, with the Line *h f* through the Head of the Figure at Right Angles to the central Line; make *c f* and *c h* each equal to one one 4th of the Height, and from the Points *h* and *f* draw Lines to the Point *d*; draw *g i* parallel to *h d* at the Diſtance of the full Stroke, which is one 8th of the Height; alſo draw *i k* parallel to *d f*, at the Diſtance of one 4th of the full Stroke. The Projection of the Graces are the ſame, as thoſe of Figure I, and are deſcribed as the oblique Graces in the Alphabet. (3) The Letter X, for theſe Uſes is thus formed, *viz.* Divide the Height into eight equal Parts, as before, and draw the central Line *a b*; make *a l*, *b m*, each equal to one 4th of the Height; on the Points *l m*, with the Radius equal to the Breadth of the full Stroke, deſcribe the Arches *n* and *o*, and draw the Lines *n m*, and *l o*; Biſect *l n* in *p*, and *o m* in *q*, and draw *p q* the central Line of the Stroke; make *a r* and *b s* each equal to *a p* and *b q*, and draw the Line *r s*; ſet the Thickneſs of the fine Stroke on each Side the Line *r s*. *Laſtly*, Set off, and deſcribe the Graces as before.

N. B. It muſt be obſerved, to place the Figure to each Hour, equally on each Side the central Line of the Hour; as Fig. VI. in Example II. is on each Side of the Line *f g m*.

P. S. To find the Height of Letters at any Height above the Eye, *vide* the Word *Letter* in the Index.

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A

Dictionarial INDEX

OF THE

Principal Matters contained in the following WORK, explaining all the TERMS of ART, in Theory and Practice, as ufed by Artizans and Workmen herein.

A B

A USED by the Ancients numerically, fignified 500; with a Dafh thus, Ā, 5000.

ABACUS, *what*; the upper part of a Capital, as E, Fig. 47, and M N Q, *&c.* Fig. 46, Plate 17; alfo *vide* p. 187, 210.

ABBREUVOIRS, the Joints in Stone-work, as *cg, di, fk, fg,* &c. Plate 32.

ABUTMENTS of Arches; *vide* p. 352, Pl. 371.

ACANTHUS-Leaf, the firft kind of Leaves ufed to adorn the *Corinthian* Capitals, *vide* p. 287, Fig. E, Plate 185.

ACCESSIBLE, that Object that may be come to for any Purpofe required.

ACRE of Land, its Length 40 Poles.

——— its Breadth 4 Poles.

——— its Quantity 160 Poles.

ACRE's Length in a Mile, League, Degree, or Circumference of the Earth; *vide* Table 1, p. 16.

ACROTERES, little Pedeftals on Pediments, as thofe marked 45, Fig. 3, Plate 33.

ACROTERIA, Pinnacles ranged on a Tower, with a Baluftrade, or Battlements between them.

ACUTE Angle, what, *vide* Def. 13, p. 117.

ADDITION, what, p. 17.

——— geometrically demonftrated, p. 410, Pl. 457.

——— the Kinds, p. 17.

——— how performed, p. 17.

——— how proved, p. 29.

——— of Integers, p. 18.

——— of Money, p. 19,—22.

——— by a new Method, p. 23.

——— of Feet and Inches } p. 30.

——— of Yards, Feet and Inches } p. 30.

——— of Fathoms, Yds, Feet and Inch. } p. 32.

——— of Rods and Feet } p. 32.

——— of Chains and Links, } p. 32.

——— of Tons, Hundreds, Quarters and Pounds, p. 33.

——— of Timber, Bricks and Lime, p. 34.

——— of Sand, p. 35.

——— of Land, p. 35.

——— of Flooring, p. 36.

——— of Gilding, } p. 37.

——— of Painting, } p. 37.

——— of folid Yards, p. 37.

——— of Time, p. 38.

ADJACENT-Angle, *vide Angles.*

A D

ADJUST, to fettle, or ftate an Account of Dimenfions taken, or to conclude a Difference.

ADMEASUREMENT, Dimenfions taken of Lands, Buildings, *&c.*

AGGREGATE, in Arithmetick the total Sum of divers Numbers added together, p. 99.

ALCOVE, a Recefs within a Chamber for a Bed of State, which fhould be afcended to by three Steps, and divided off from the Chamber by a magnificent Arch, or Colonade.

ALIQUOT-parts, fuch as are contained in a given Quantity any Number of times without a Remainder, as 3 is contained in 12, 4 times; 4 in 20, 5 times, *&c.* not the 3's in 13, becaufe there 1 remains, *&c.*

ALPHABET, how defcribed geometrically, p. 426.

ALTARS, from *Altus*, high, a Place facred for divine Worfhip in Churches, which are generally enriched with

ALTAR-Pieces, Compofitions of Architecture, Painting, *&c.* as that by *Serlio*, p. 244, Plate 89.

ALTERNATE-Angles, *what*, p. 123.

ALTIMETRIA, the Art of meafuring the Heights of Buildings, *&c.*

ALTITUDE, *Height*, as the Altitude of a Figure, *&c.* is the Height, or neareft Diftance from its Bafe to its Top, p. 123.

AMBIT of a geometrical Figure, is the Sum of all the Circumference; fo the Ambit of a Circle is all its Circumference; of a Triangle, all its three Sides; and of a Square, all its four Sides, *&c.*

AMBLIGONIUM-Triangle, *vide* Def. 30. p. 120.

AMPHIPROSTYLE, a Portico of a Temple, confifting of four Columns, as Fig. B, Plate 119.

ANALOGY, the Relation which divers Things, as Numbers, bear to each other; that is, as 5 is to 12, fo 10 is to 24, *&c.*

ANCHORS, or rather *Darts*, an Ornament introduced between Eggs, carved in an Ovolo, as Fig. K, Plate 324.

ANCONES, the fquare Returns at the Angle of a Door or Window, as thofe in Fig. A, B, C, D, Plate 366.

ANCIENT Orders, firft us'd, were the *Dorick*, *Ionick*, and *Corinthian*, p. 201.

ANGLE,

A Dictionarial Index.

A N

ANGLE, what, Def. 8. p. 117.
—— *Plain*, Def. 8.
—— *Spherical*, Def. 9. p. 114.
—— *Mixt*,
—— *Adjacent*, or *Contiguous*, ſuch as have one Leg common to both Angles, as the Angle *a b e* is contiguous, or adjacent to the Angle *b c a*, and the Leg *a c* common to both Angles.
—— *Acute*,
—— *Right*, Def. 13, 14, 15. p. 117.
—— *Obtuſe*,
—— *Oblique*, thoſe that are not right-angled
—— *Oppoſite*, thoſe that are made by the Interſection of two Right-lines, as by the Lines *e f* and *a b*, Fig. 5, Plate 2, where the Angle *e h b* is oppoſite to the Angle *a h f*, ſo likewiſe the Angle *a h e* is oppoſite to the Angle *b h f*, &c.
—— how expreſs'd by three Letters, p. 118.
—— its Quantity, how taken by a two-foot Rule, *&c.* and delineated, p. 165, 166.
—— how meaſured, p. 116.
—— Right-lin'd, how divided, p. 126.
—— their Complements, what, p. 117.
—— to make equal to an Angle given, p. 113.
—— to make equal to a ſolid Angle given, 134.
—— Internal and External, what, p. 166.
—— Solid is made by the Meeting of three or more Angles in a Point
—— Alternate, thoſe which are reſpectively equal to one another.

ANGULAR Point, that Poin where the two Sides, or Legs of an Angle meet, ast the Point *a*, Fig. 8, Plate 1.

ANNULET, what, p. 237, Plates 51, 52.

ANTÆ, or ANTES, p. 236.

ANTICK Compoſition, a Confuſion of Men, Birds, Beaſts, Flowers, Fruits, Fiſhes, *&c.* repreſented by Painting or Sculpture.

ANTICUM, *Latin*, a Porch before a Door.

ANTIPAGMENT, *Latin*, the Jaumbs, or Architrave to a Door, Window, or Chimney, either plain or carved.

ANTIQUE Statues, Buſts, Medals, *&c.* ſuch that were made by the ancient *Greeks* and *Romans*.

APERTURES, or APERTIONS, from the *Latin Aperio*, an Opening, *viz.* Doors, Windows and Chimneys.

APEX, the uppermoſt Point of a Cone, Angle, *&c.*

APIARY, a Place wherein Bees are kept.

APOPHYGE, what, and how deſcribed, p. 207.

AREOSTYLE, what, p. 238. Plates 53, 54.

ARCADE, an Arch, as Fig. 3, Pl. 30, p. 221.

ARCH, *Latin*, *Arcus*, a Bow.

ARCHES, the kinds, are *ſtreight*, as A B C, Plate 355; or *ſcheme*, as D E F, Plate 355; or *ſemicircular*, as A, Plate 356; or *ſemicircular*, as B and C, Plate 356; or *Gothick*, as D, E, F, G, H, I, all which may be made rampant, as A, B, C, Plate 363.
Arches, how divided, p. 335.
—— their Skew-backs,
—— how ruſticated, p. 338.
—— how made rampant, p. 339.
Arch-line, how divided, p. 138.

ARCH-BOUTANT, an arched Buttreſs, as thoſe againſt *Hen.* VII's Chappel at *Weſtminſter*.

ARCHITECTONICK, of, or belonging to a Building.

A R

ARCHITECTUS *Ingenio*, a Perſon well skilled in Arithmetick, Geometry, and all other Arts by which Buildings in general are performed.

ARCHITECTUS *Sumptuarius*, a Builder well ſtored with Money, *&c.*

ARCHITECT, a Perſon skilful in the Theory and Practice of Buildings in general.

ARCHITECTURE, the Art of Building.

ARCHITRAVE, *vide* p. 210.

ARCHIVAULT, from the *French Archivolte*, the Quoin, or Face of an arched Vault.

AREA, the ſuperficial Content of any geometrical Figure; or 'tis the Number of ſquare Inches, Feet, *&c.* contained on the Surface of any given Figure,

ARITHMETICK, the Art of Numbers, which herein is performed *vulgarly*, *decimally*, *duodecimally*.

ART, of *Ars*, *Latin*, that which is performed by help of *Arithmetick*, *Geometry*, *Grammar*, &c.

ARTS, Liberal, *Grammar*, *Rhetorick*, *Arithmetick*, *Geometry*, *Aſtronomy*, *Sculpture*, *Muſick*.

ARTIST, or ARTIZAN, a Perſon skilful in an Art, as the Art of *Painting*, *Building*, *Gardening*, *Sculpture*, &c.

ARTIFICER, a Workman employed in Buildings, as a Carpenter, Joyner, Smith, *&c.*

ARTINATURAL Lines, Serpentine Lines, deſcribed by Art geometrically) to repreſent thoſe made by the natural Motion of a Snake or Serpent, as *d*, and C, Fig. 4, Plate I.

ASCENT, of Stairs, what, p. 384.

ASTRAGAL, what, p. 210.

ATTICK, belonging to *Attica*, or the State (or City) of *Athens* in *Greece*.

ATTICK BASE, what, p. 237,
Attick Baſe geometrically deſcribed by *Oſio*, p. 229, Plate 47; by *Alberti*, p. 230, Pl. 49.
Attick Cornice, *vid.* D,
—— Window, *vide* B, Plate 160.
—— Story, *vide* A,

ATTITUDE, from the *Italian*, *Attitudo*, the Action, or Poſture in which a Figure is placed.

AVENUE, a Paſſage or open View before a Building, *&c.*

AXIS, a Right-line conceived to paſs through the Midſt of a Solid, from its Vertex to the Center of its Baſe, about which the oppoſite parts of the Solid may revolve. The Axis of a Globe is a Right-line paſſing through the Center from one ſide to the other.

B A

THE Letter B, did anciently ſignify numerically 300, and with a Daſh thus, B̄, 3000.

BAGS of Lime, in one Hundred, p. 35.

BAGNIO, *Italian*, a Bath, which is alſo called *Circus*. The Baths of the *Romans* (as that of *Diocleſian*) were Buildings of the greateſt Magnificence, that Art and Expence could produce.

BAGUETTE, the cylindrical piece of Wood, fixed on the Hip of a plain-til'd, or ſlated Roof, on which the Lead-covering of the Hip is laid. In Architecture it ſignifies that ſmall Member, or Moulding, which we call a *Bead*, when carv'd into pearls, *&c.* as thoſe between the Faſcia's of the Architrave in Plate 288, which is then called by *S. le Clerc*, a *Chaplet*.

BALCONY, from the *French Balcon*, a kind of open Gallery againſt a Building to ſtand in, and

and behold any Action, &c. page 329.

BALDACCHINO, the ſacred Canopy over the high Altar in St. *Peter's*, at *Rome*.

BALNEUM, the ſame as *Bagnio*, a Place for bathing.

BALUSTER, (corruptly) called *Banniſter*; their Uſe is to ſupport the Hand-rail of a Stair-caſe, &c. are either plain or carved, and made agreeable to the Order with which they are introduced. The Word comes from the *Latin*, *Baluſtrum*, the Flower of the wild Pomegranate, which ('tis likely) was originally repreſented in their Carvings. For their Kinds, Lengths, and Manner of dividing them in a Stair-caſe, &c. ſee p. 389.

BALUSTRADE, a Range, or Line of *Baluſters* complete, with their Baſe and Capping; whoſe Height, when on the Ground, is ſuch, as for a Man to reſt his Elbows thereon, but when above the Eye, muſt be proportioned to the Place wherein it ſtands, p. 328, 329.

BAND, the ſame as *Faſcia*.

BANDELET, from the *French Bandelette*, a *Fillet* under the Aſtragal at the Top of a Column, as the Fillets *s* and *w*, Plate 19.

BASE, *vide* p. 211.

Baſe of a { Pedeſtal, p. 180. / Triangle, p. 121. / Column, p. 187. }

BASILICK, from the *Greek Baſilike*, Royal, Halls of State, with Portico's, Iſles and Tribunal, wherein anciently the Kings themſelves adminiſtered Juſtice. The Name is alſo given latterly to *Churches* and *Temples*, but I think with very great Impropriety.

BASS-RELIEVO, a Manner of repreſenting Statues, &c. on the Superficies of a Plane in a Pictoriſque Manner, wherein the Figures are imboſs'd, or raiſed very little above the Plane.

BASTONE, what, p. 237.

BANDEAU, *French*, the ſame as *Archivault*.

BATARDEAU, *French*, a Coffer-dam, made in a River to keep off the Water, whilſt the Pier of a Bridge, or any other Building be erected.

BEAD, *vide Baguette*.

BEAMS, large Timbers laid on the Walls of the Carcaſs of a Houſe, cogg'd down into the Plate, and on which the principal Rafters are framed; their Uſe is, to prevent the Thurſt of the Roof from forcing out the Walls on which the Roof is placed, and to tye in the Walls alſo; for their Diſtance, Manner of cogging, and Scantlings, *ſee* p. 360, 361.

BECKS, the ſaliant, ſolid Angles of the Pier of a Brick or Stone-bridge.

BED-MOULDING, the ſeveral Mouldings of the Cornice taken together, that are next below the *Corona*, as the Mouldings *g*, *h*, *i*, *k*, *l* in Pl. 19.

BEVEL-angled, that which is not right-angled, therefore every acute and obtuſe Angle is a Bevel Angle.

BINDING-JOISTS, *vide* p. 365.

To BISECT a Right-line, *vide* p. 126.

BLOCK-CORNICE, what, page 226, Plates 45, 216.

BLOCK-RUSTICKS, what, page 214.

BODY, a Magnitude, that is contain'd under three Dimenſions, *viz.* Length, Breadth, and Depth, or Thickneſs.

BOND-TIMBERS, what, p. 353.

BOULTIN, a Moulding, the ſame as *Ovolo*.

BOLECTION-work, Wainſcotting with raiſed Pannels.

BRACKET, for Coves and Cornices, how cut for the Front, or Angles of a Building, p. 376.

BRANCA URSINA, what, p. 287.

BRIDGING-JOISTS, p. 356.

BUFFET, a Niche made in the Angle or Side of a Dining-room for Plate, Glaſſes, China-ware, &c.

BUREAU, or *Buroe*, from the *French*, a Cabinet of Drawers.

BUST, from the *Italian*, (*Buſto*) the Figure, or Likeneſs of a Perſon, repreſenting the Head, Shoulders and Stomach only, as on the Chimney-piece, Plate 431.

BUTMENT, *vide Abutments*.

BUTTRESS, a Support to Walls to prevent their falling, or being forced out of an Upright, by the Thruſt of a Roof wherein no Beams are uſed to prevent it, as in the Roof of *Weſtminſter-hall*, which would force out the Walls that ſupport it, and fall down, were it not kept in its Place by the ſtrength of *Buttreſſes* withoutſide.

C A

THE Letter C numerically ſignifies 100.

CABLINGS, what, how deſcribed and enriched, p. 266, 294.

CAMBER-BEAMS, Beams cut with an Obtuſe-angle in their Middle to help prevent their ſagging, as Fig. B, plate 375.

CAMERATED, Vaulted, arched, cieled, &c.

CANALICULÆ, the angular Hollows cut in the *Dorick* Triglyph, as in Fig. 8, Plate 53, 54, which is a Section of a Triglyph, where B A are the *Canaliculæ*, and D C the *Semicanaliculæ*.

CANT, the Side of a regular Polygon, as of a Pentagon, Hexagon, &c.

CANTALIVER, a carved Modillion ſuſtaining a Cornice, as Fig. 12, Plate 263.

CANTALIVER-Cornice, a Cornice wherein *Cantalivers* are uſed, as in Plate 263.

CAPITAL, what, p. 210.

——— of various Compoſitions, p. 326.

CARACOL, a Stair-caſe of a ſpiral Form, as in Plate 448.

CARIATYDES *Order*, inſtituted by the ancient *Greeks*, in Memory of their having ſubdued the rebellious *Cariatydes*, a People of *Caria*, repreſenting their captive Wives placed in the ſtead of Columns, as a Symbol of their Obedience, Servitude and Slavery. In the ſame Manner came the *Perſian* Order, by the *Perſians* being vanquiſhed by the *Lacedæmonians* at *Platæa*, p. 326.

CASCADE, a Water-fall, or Cataract made by Art.

CARDINAL POINTS, of the Horizon, p. 138.

CARTOOSES, *Cartouzes*, or *Cartouches*, a kind of Bracket, or Truſs for the ſupport of Cornices over Doors, Windows, or Window-ſtools, as O P, plate 365.

CATARACT, a great Fall of Water made by Nature.

CATENARIA, the Curve Line, into which a Chain forms itſelf, when it hangs freely between two Points of Suſpenſion.

CATHETA, a Perpendicular let fall from the *Abacus* of the *Ionick* Capital, paſſing through

 the

the Center of the Eye of the Volute, as A C, Plate 138, which *Sebastian le Clerc* calls the *Axis*.
CATHETUS, the Perpendicular of a right-angled plain Triangle, as *r p*, Fig. 14, Plate 1.
CAVUS, what, p. 209.
CAVETTO, what, p. 187, 209.
——— how described, p. 208.
——— how enriched, p. 294.
CAUKING, *Cogging*, or *Cocking* of Beams, &c. down on Plates, the letting of a Dove-tail, cut in the under Face of the End of a Beam, into a Dove-tail concave made in a Plate, as Fig. S T, Plate 375, whereby they cannot draw asunder.
CAULICOLI, the Volutes of the *Corinthian* Capital, as C, Fig. 1, Plate 201.
CAULICOLES, small Volutes of the *Composite* Capital, finishing with a Rose, as represented at large in Plate 281.
CIELING-JOISTS, p. 355.
CIELINGS, coved, p. 381.
——— their Ornaments, *ibid.*
CIELING-PIECES, p. 380.
CELERITY, the same as *Velocity*, or Swiftness.
CENTER *of a Circle*, what, p. 119.
——— how found, 137.
Center of Gravity, a Point, upon which if a Body was suspended, all its parts would be *in Æquilibrio.*
Center of an Ellipsis, a Point where the two Diameters intersect, as *g*, Fig. 59, Plate 5.
Center of Motion of a Body, a Point, about which a Body being fastened may, or doth move, as the Center of a Pulley, or the Middle of a Balance is the Center of its Motion.
Center of a Sphere, or Globe, a Point, from which all Lines drawn to its Surface are equal.
Center of a Square or Parallelogram, a Point where its Diagonals intersect, as *i*, Fig. 14, Pl. 1.
CENTRAL-Line of a Column, a Right-line passing directly through the Midst of the Column, as the Line *d* 28, Fig. 140, Plate 15, from whence the Projection of the Members is accounted, by Mr. *Evelyn.*
CENTER, for turning Arches of Brick or Stone, how made, p. 377, 379.
CENTER, of a Column, or round Tower, &c. how to find without-side.
Practice, Fig. 4, *Plate* A, *following Plate* 369.
(1) Apply the strait Edge of a Board, whose length is known, thereto, as *g n*, and measure the Distances, *g h* and *n l*. (2) On Paper, with a Scale of equal parts, draw a Right-line representing the length of the Board, and at each End set off Perpendiculars equal to the Off-sets *g h* and *n l*; then, by Prob. 26, p. 137, find the Center of a Circle, that shall pass through the Points *g*, *k*, *l*, as the Point *e*.
CELLAR, how plann'd, p. 181.
CHANNEL, of the *Ionick* Capital, is that part of the Capital that is next above the Ovolo, as 3, Fig. 1, Plate 126.
CHAPITER, or *Chapter*, from the *French*, *Chapiteau*, the Crown or *Capital* of a Pillar or Column, of which there are two Kinds, *viz.* those with *Mouldings*, which have no Ornaments, as the *Tuscan* and *Dorick* Capitals; and those with *sculptur'd Ornaments*, as the *Ionick*, *Corinthian* and *Composite*, of which, in the following Work, is a very great Variety.
CHAPLET, *vide Baguette.*
CHAPTRELS, *Carved Imposts*, as of the *Ionick*, *Corinthian* and *Composite* Orders, as Fig. V. &c. Plate 126.
CHIMNEY-PIECES, various Designs, p. 382.
CHORD-LINE, what, p. 119.
CHAIN, its Length, *vide* Table I. p. 16.
Chain square, vide Table II. p. 16.
Chain's Length in a Rood, Furlong, or Acre's length, *vide* Table I. p. 16.
———in a Mile,
———in a League,
———in a Degree,
———in the Circumference of the Earth.
CIMA RECTA, what, p. 187, 409.
———how described, p. 207.
CIMA INVERSA, or *Reversa*, what, p. 187. 209.
———how described, p. 207.
CIMACIO, *Italian*, the same as *Cymatium.*
CINCTURE, what, p. 206.
CYPHER, its Use, p. 11.
CIPPUS, a little Column, or rather a Cylinder, erected on a Column in Memory of something remarkable, as the Cippus or Cylinder A, Fig. 1, plates 95, 96, on B, the monumental Column of *London*, in Memory of the Conflagration, &c.
CIRB-ROOF, what, p. 367.
CIRCLE, what, p. 112.
——from whence originally taken, p. 200.
——how generated,
——how completed, a part being given, p. 113.
——its Center, how found,
——its Circumference, how traced, p. 148.
CIRCLE INSCRIBED
within an Equilateral, p. 157.
within a geometrical Square, p. 113.
within a regular Polygon,
CIRCLE CIRCUMSCRIBED
about a Pentagon, p. 160.
about a geometrical Square,
CIRCULAR LINE, what, p. 113.
CIRCUMFERENCE of a Circle, what, p. 113.
———how divided into Degrees, p. 113.
——— of the Earth, what, p. 16.
CIRCUMVOLUTION, in Architecture, a *Turning-about*, as the turning, or describing of a Volute. *Vide Volute.*
CIRCUMSCRIBING FIGURES, what, p. 137.
CIRCUS, a spacious *Circular Theatre* for exhibiting of Spectacles to the Populace; Baths were also called *Circuses.* Vide *Baths.*
CITY, how plann'd, p. 180.
COFFERS, square Concaves in the Sofito of the *Corinthian* Order between the Modillions, which are generally enriched with Roses of various kinds, as represented in the Sofito, Plate 155.
COLLARINO, *Italian*, the Astragal at the top of the Shaft of a Column, (not the Freeze of the Capital next above it in the *Tuscan* and *Dorick* Orders, as many understand it to be.)
COLLAR-BEAM, a small Beam framed into, or near the midst of a pair of principal Rafters, to strengthen them, (and sometimes to help support the *Purlins*) as those marked 2, in Pl. 374.
COLONADE, a Range, or Ranges of Columns placed before, on the sides, or entirely about, or within a Building, at an assigned Distance, as in the Plan of the Temple of *Jupiter*, Plate 118. *Note*, When a Colonade cannot be seen at one View, 'tis called a *Polystyle Colonade*, as the Colo-

Colonade aforeſaid.

COLOSSUS, any Statue or Column of an enormous ſize, as the famous Statue of *Rhodes*, dedicated to the Sun, which was 70 Cubits high, and coſt about 44,000 *l.* ſterling. It was placed at the entrance of the Harbour, the right Foot on one ſide of the Land, and the left on the other; the Height was ſo great, that the talleſt Ships could ſail between the Legs; the Magnitude of the little Finger was ſuch, that few Men could encompaſs it with both their Arms. It was thrown down by an Earth-quake, and the Braſs of which it was made, loaded 900 Camels; this wonderful Work was made by *Chares*, who completed it in 12 Years.

COLUMNS, what, p. 187.
——their Proportions, *ibid.*
——how diminiſhed, p. 194, 210.
——how canted, p. 238.
——how ruſticated, p. 220.
——how fluted, p. 235.
——how wreathed, p. 327.

The Kinds are five, *viz. Tuſcan*, *Dorick*, *Ionick*, *Corinthian* and *Compoſite*, which are differently proportioned according to the ſeveral Maſters contained in this Work.

COLUMNS PARTICULAR are ſuch that are diſtinguiſhed according to their various Situations and Uſes, *viz.*

1. *Angular*, a Column inſerted into the Angle of a Building, as thoſe in the Angles of the Tower of St. *Bride*'s in *Fleet-ſtreet*.

2. *Doubled*, that is, where the Shafts of two Columns penetrate each other, with about a 3d of their Diameters, as is done (tho' not to be commended) by Sir *Chriſtopher Wren*, within the Church of St. *Bride* aforeſaid.

3. *Coupled*, as the extream Columns in Pl. 93.

4. *Caroltick*, a Column enriched with Foliages, or Branches twiſted ſpirally around the Shaft.

5. *Triumphal*, a Column erected in Honour of a Hero, as that of the late Duke of *Marlborough* at *Blenheim*.

6. *Chronological*, ſuch as bear an hiſtorical Account of Facts, digeſted according to the Order of Time.

7. *Hiſtorical*, one whoſe Shaft is adorned with *Baſſo-relievo's* in a ſpiral Manner, as the *Trajan* Column at *Rome*, vide plates 42, 112.

8. *Coloſſal*, one of an enormous ſize, too large to be employed in any Ordinance of Architecture, as the Monumental Column of *London*.

9. *Hermetick*, a ſort of Pilaſter made in manner of a *Terminus*, with the Buſt, or Head of a Man for its Capital, as repreſented on the Right-hand of plate S, following plate 318.

10. *Polygonous*, the ſame as a *canted* Column, whoſe Baſe is an Octagon, *&c.*

11. *Elliptical*, ſuch whoſe Baſe of the Shaft is an Ellipſis, which is to be uſed, where the Thickneſs in Depth of a *circular* Column would be too thick, and where a Column of Diameter equal to the given Thickneſs would be too ſhort and weak.

12. *Funeral*, a Column crown'd with an Urn, wherein is ſuppoſed to be the Aſhes of the Deceaſed, with its Shaft enriched with *Tears* and *Flames*, Symbols of Sorrow and Mortality.

13. *Inſerted*, ſuch as are attached to a Wall, a third or fourth of their Diameter, as repreſented in Plate 354.

14. *Inſulate*, one that ſtands free on all ſides, detached from all other Bodies, as the *Monumental Column* on *Fiſh-ſtreet-hill*, *London*.

15. *Grouped*, ſuch as ſtand by 3, 4, *&c.* on one Pedeſtal.

16. *Sepulchral*, one erected on a Tomb or Sepulchre, with an Inſcription on its *Baſe*.

17. *Statuary*, a Column which ſupports a Statue, as that of *Trajan* in Plates 95, 96.

COMMON EXCESS, what, page 99.

COMMOM DIVISOR, a Number which exactly divides any two (as the Numerator and Denominator of a Fraction) without leaving a Remainder.

COMMENSURABLE *Quantities*, ſuch as will meaſure one another preciſely, as 4 will meaſure 8, 12, 16, 20, *&c.* without a Remainder; ſo likewiſe 3 will equally divide 6, 9, 12, 15, 18, *&c.*

COMPLEMENT *of an Angle*, what, p. 171.
——*of Degrees* in a Quadrant or Semicircle, p. 118.

COMPOUND FIGURES, what, p. 122.

COMPOSITE ORDER,
——by *Carlo Ceſare Oſio*, p. 301, 302, 303.
——by *Julian Mau-clerc*, p. 303, 304.
——in the Arch of *Titus* } at *Rome*, p. 304.
——in the Caſtle of *Lions* } at *Rome*, p. 304.
——by *Palladio*, } p. 305,—309.
——*Scamozzi*, } p. 305,—309.
——*Barozzio*, p. 306, 309.
——*Serlio*, } p. 309, 310.
——*Le Clerc*, } p. 309, 310.
——*J. Mau-clerc*, p. 311.
——Sir *Chriſtopher Wren*, } p. 313.
——Mr. *John Gibbs*, } p. 313.

CONCAMERATE, to arch, or cove the Cieling of a Chamber.

CONCATENATE, to chain the Out-walls of a Tower, *&c.* together.

CONCAVE, the inward Superficies of a hollow Veſſel.

CONCAVITY, the ſpace contained by the ſuperficies of a *Concave*.

CONCENTRICK Circles, thoſe that have one and the ſame Center, as the Circles *a*, *o*, *z*, Fig. 9, pl. 1.

Concentrick Ovals are thoſe that are deſcribed on the ſame Centers, as in Fig. 59, plate 5.

Concentrick Polygons, are ſuch whoſe ſides are parallel to each other, and have but one Center common to both, as Fig. 90, plate 6.

CONCURRING *Figures*, ſuch that are in every reſpect equal to one another.

CONE, a geometrical Solid, generated by the Revolution of a right-angled plain Triangle, whoſe Perpendicular, or *Cathetus*, is made the Axis of its Motion.
——its Superficies, how covered with Lead, *&c.* page 346.

CONJUGATE Diameter, of an Oval, or Ellipſis, the ſhorteſt, as *ef*, Fig. 60, plate 5.

CONNOISSEUR, *French*, a Perſon (curious and) ſkilful in Arts.

CONSECTARY, a conſequent Truth ariſing from a *Demonſtration*; the ſame as *Conſequence*, or *Corollary*.

CONSEQUENT, the laſt Term in any Set of Pro-

C O

Proportionals, suppose the following; As 5 is to 12, so is 10 to 24: Now here the last Term 24 is the *Consequent*, or *Consequence* of multiplying (the Means) 12 by 10, and dividing their Product by 5, which gives 24 for the Quotient, and is a fourth Proportional.

CONSOLE, the Key-stone of an Arch, (from the *French*, *Consolider*, to close up) as B, Plate 208, whose Profile at large is B, pl. 209, also in the bottom of Plate 307.

CONSTRUCTION, of geometrical Figures, is the Formation, or making of them.

CONTACT, *Point of Contact*, the Point where a Tangent, or Right-line touches the Arch of a Circle, as in Fig. 95, Plate 6, the Right-line *a b* touches the Circle *o b c* in *b*, its Point of Contact.

CONTENT, the Area of any superficial Figure, or Solidity of any solid Body, which is accounted in square or cubical *Inches*, *Feet*, *Yards*, &c. *viz.* If a square Superficies have each side equal to 3 Feet, its Content is 9 square Feet; and if a Cube have each side equal to 3 Feet, its solid Content is 27 cubical Feet, &c.

CONTINUED *Proportion* is, where the 3d Term is to the 4th, as the 1st is to the 2d; and consequently the first and third Terms are of one Denomination, and the second and fourth of another. *Continued Proportion* is the *Golden Rule Direct*, vide p. 87, and its Characteristick, used by Geometricians, is as thus, ∺

CONTOUR, the Out-line of any Member or Ornament.

CONVEX, the outer Superficies of a Sphere or Globe, as *Concave* is the inward Superficies.

CONVEXITY, the outward Curvature of a Globe, Spheroid, or any other curved Body.

CORBELS, coved Trusses made for the Support of Statues, Busto's, &c. The Holes left in the Walls of ancient Churches, &c. for Statues to stand in, are by some called *Corbels*, but (I think) very improperly.

CORINTHIAN ORDER,
——by *Carlo Cesare Osio*, p. 281, to 284.
——in the Temple of *Jerusalem*, }
——in an Altar of the *Rotunda*, } p. 285.
——in the Portico of the *Rotunda*, }
——in the Bath of *Dioclesian*, } p. 286.
——in the Frontispiece of *Nero*, }
——by *Palladio*, }
———*Scamozzi*, } p. 289, 292.
———*Barozzi*, p. 290, 292.
———*Serlio*, p. 291, 292.
———*Barbaro*, p. 292.
———*Viola*, }
———*Alberti*, }
———*Cataneo*, }
———*de Lorme*, } p. [illegible]
———*Bullant*, }
———*Le Clerc*, }
———*Perrault*, p. [illegible]
———*Julian Mau-clerc*, p. 296, 297, 298.
———*Inigo Jones*, p. 298.
———Sir *Christopher Wren*, p. 299.
———Mr. *John Gibbs*, ibid.

CORINTHIAN CAPITAL, from whence taken, and by whom first made, p. 287.

CORNICE, what, p. 209.
———of a Pedestal, what, p. 187.
———of an Entablature, what, *ibid.*
———for Doors and Windows, pl. 298, 299.

C O

CORONA, what, p. 187, 209.

COROLLARY, an useful Consequence drawn from a geometrical Proposition.

CORRIDOR, a circular or square Colonade, or a Gallery about a Building, which leads to all its several Appartments.

CROSETTE, the same as *Ancones*, which is also called *Prothyrides*.

CROSS-MULTIPLICATION, p. 60.

CUBE, a solid Body generated by the Motion of a geometrical Square, erected perpendicularly on a Plane, and moved regularly along a Right-line, whose Length is equal to the side of the Square: Its Surface is terminated by six equal Squares, and its Figure is a Dye truly made.

CUBE-ROOT is the side of a Cube, whose Solidity is equal to a Quantity given. When a Number representing a Quantity is given to find its Cube-Root, that Number or Quantity must be conceived to be a Cube, containing as many cubical Inches, Feet, &c. as the Numbers express; and to find the Root of such Number is no more, than to find the Length of a Side of such a Cube, which is called *Extracting its Root.* Vide *Extractions of Roots.*

To CUBE a Number is to multiply it into itself, and the Product into it again, as for Example, to cube the Number 3; first, 3 multiplied into 3, the Product is 9; and then 9 multiplied into 3 again, the Product is 27, which is the Number cubed.

CUBIT, anciently was a Length from the Elbow to the Finger's end, but now fixed at 18 Inches.

CUPOLA, a hemispherical concave Roof, or Covering for a magnificent Building, generally called a *Dome*, which anciently admitted the Light at the Top, or Zenith-point only, without any Lanthern, as in Plate 191, and which is yet to be seen in that incomparable Piece of the *Pantheon* at *Rome*; but indeed I must own, as this Climate is more subject to unsettled and wet Weather, 'tis better to admit the Light otherwise, and finish their Vertex, either with a Husk, Pine-apple, Ball, Vase, &c. as in Plate 189, or with a Lanthern and Ball, &c. as in Plates 188, 391.

Cupola's, how framed, p. 369.
—— —how ornamented, p. 381.

CURVATURE, the Bending of a Line, or Surface.

CURVES, crooked or arched Lines, of which there are many kinds, but those which relate to our Purpose are,
Regular, }
Irregular, } p. 113.
Spiral, }
Serpentine, } p. 114.

CURVILINEAL Figures, are those whose Spaces are bounded by a curved Line, as a Circle, Ellipsis, &c.

CYLINDER, a solid Body, whose Base is a Circle, and is generated by the Revolution of a right-angled Parallelogram about one of its Sides, or by the Motion of a Circle, erected at Right-angles to the Surface of a Plane, moved regularly thereon in a Right-line, from a given Point, to a Distance equal to the required Length of the Cylinder.

CYLINDROID, a Cylinder whose Base is an Ellipsis.

CYMATIUM, or *Cymaise*, what, p. 117, 209.
———how

D A

——how enriched, p. 294.

D A

D, IN *Latin*, ftands for 500.
DADO, what, p. 211.
DARTS, p. 329.
DECAGON, p. 122.
DECASTYLE, a *Portico*, that hath ten Columns, as the Temple of *Jupiter*, Pl. 188.
DECIMAL *Arithmetick* geometrically demonftrated, p. 426.
DECORATIONS, the Ornaments, or Enrichments that adorn a Building.
DEFINITION, a full and plain Defcription of a Point, a Line, a Superficies, *&c.*
DEGREE, what, p. 16, 115.
Degrees in the Circumference of the Earth, p. 16.
DELINEATE, to draw, or reprefent by Lines any Plan, Elevation, *&c.*
DEMONSTRATE, to prove, to fhew, to make plain, by evident Proofs, the Truth of a Propofition, *&c.*
DEMONSTRATION, a clear and convincing Proof.
DEMY King-poft, what, p. 353.
DENOMINATOR, of a Fraction, what, p. 71.
DENTICLES, or *Dentil-cornice*, what, p. 280.
DEPENCILLED, *defigned* (or drawn) with a Pencil.
DESCRIBE, to draw, or reprefent by Lines a geometrical Figure, *&c.*
DESCRIBENT, that Line, which by its Motion generates a Superficies; or that Superficies, which by its Motion generates a folid Body. Vide *Generation of geometrical Figures.*
DESIGN, the Diftribution and Proportion of the Parts, into which a Plan, or Elevation for a Building is divided.
DIADEMA, the Tenia of the *Dorick* Order, as the Member I, Fig. I, Plate 60.
DIAGONAL of a geometrical Square, what, p. 122.
DIAGRAM, a geometrical Figure, confifting of divers Lines drawn for its Demonftration, *&c.*
DIAMETER, of a Circle, what, p. 119.
———how found, p. 205.
———of a Square, what, p. 122.
DIAMETRICALLY, that which paffeth directly through the Center of a Circle, *&c.* from fide to fide.
DIAMOND-Pavement, *vide* Plates 450, &c.
DIAPHANOUS, that which is tranfparent, as Glafs, *&c.*
DIASTYLE, an Intercolumnation of three, and fometimes four Diameters, p. 238.
DIATHESIS, the fame as *Difpofition.*
DIGLYPH, an imperfect Triglyph, or rather a Confole with two Channels only, as thofe in the Freeze of the Entablature, Plate 263.
DILAPIDATION, a Building, or Buildings in Ruin, for want of having been timely repair'd.
DIMINISHING of Columns, how, *vide* p. 194, 210.
DIMINUTION of Columns, from whence taken, p. 195.
———the Quantity of Diminution in each Order gener ally is as follows;

D I

The Shaft of the		Column is diminifhed at its Aftragal		of its Diameter.
	Tufcan		$\frac{1}{4}$	
	Dorick		$\frac{1}{5}$	
	Ionick		$\frac{1}{6}$	
	Corinthian		$\frac{1}{7}$	
	Compofite		$\frac{1}{8}$	

DIPTERE, a Temple, *&c.* environed with two Ranges of Columns, as Plate 188.
Line of DIRECTION, the Line made by the Motion of a natural Body, in its Afcent, Defcent, *&c.* according to the Power impreffed upon it.
DIRIGENT, the Line or Path, along which the Defcribent Line, or Superficies is carried, in the Genefis or Generation of a Superficies, or of a Solid.
DISPOSITION, or *Diftribution* of Parts, the well-difpofing of the feveral Parts and Members, into which a Plan, or Elevation of a Building is divided according to their proper Places, Ufes, *&c.*
DISTANCE, to determine, p. 174.
DITRIGLYPH, the fame as *Metope*, the Space between two Triglyphs in the *Dorick* Freeze.
DIVIDEND, a Number given to be divided, p. 66.
DIVISION, what, p. 65.
———how performed, p. 66.
———Single, p. 67.
———Compound, p. 68 to 71.
———how proved, p. 73.
———how contracted, p. 72.
Divifion of geometrical Figures, p. 414, to 417.
DIVISOR, what, p. 66.
DODECAGNO, or *Duodecagon*, a regular Polygon of 12 equal fides, and as many equal Angles, *vide* p. 122, 142, 152.
DODECAHEDRON, one of the regular *Platonick* Bodies, bounded by 12 equal and equilateral Pentagons.
DOME, *vide Cupola.*
———how framed, p. 369.
——— of St. *Paul's*, *London*, ibid.
——— its Plan, Section, and Manner of framing, p. 370.
DOOR of the *Rotunda* at *Rome*, p. 286.
Doors Tufcan, Plates 40, 44.
—— *Dorick*, Plates 70, 74, 78, 100, 101.
—— *Ionick*, Plates 123, 124.
—— *Corinthian*, p. 301.
—— *Compofite*, Plate 295.
—— rufticated, Plates 45, 46, 69, 74.
DORICK Order,
———by *C. C. Ofio*, p. 227, to 234, Plates 47, 48, 49, 50.
———of *Marcellus* at *Rome*, p. 237, Plates 51, 52.
———of *Vitruvius*, p. 238, Plates 53, 54.
———of *Dioclefian* at *Rome*, p. 239.
———of *A. Palladio*, p. 239, Plates 59, 60.
———of *Scamozzi*, p. 240, Plates 61, 62.
———of *Barozzio*, p. 240, Plates 64, 65.
———of *Serlio*, p. 242, Plate 73.
———of *S. le Clerc*, p. 244, plate 80.
———of *C. Perault*, p. 245, plate 85.
———of *Viola*, ———of *Alberti*, ———of *P. de Lorme*, p. 247, plate 87.

D O

Dorick Order of *Bullant*, p. 247, plate 87.
——— of *Barbaro*, } p. 247, plate 88.
——— of *Cataneo*, }
——— of *J. Mau-clerc*, p. 247, plates P, K, 89, 90, 91.
——— of *Inigo Jones*, p. 249, plates 92, 93.
——— of Sir *Christopher Wren*, p. 249, pl. 94, 95, 96, 97.
——— of Mr. *John Gibbs*, p. 253, 254, pl. 98, 99, 100, 101.
Dorick on *Tuscan* Order, p. 245, plate 84.
DOVE-TAIL, what, p. 353.
DOUCINE, vide *Cima inversa*.
DRAMS in an Ounce, Pound, &c. p. 16.
DYE, of a Pedestal, the same as *Dado*.
DYPTERE, the same as *Diptere*.

E

E, Numerically signifies 250.

ECHINUS, the same Member as *Ovolo*,

ECPHORAS, the Quantity of Projection, that any Member of a Capital or Entablature hath before the upright of a Column.

EGGS of an Ovolo, how described, &c. p. 148, 213, 229.

ELEMENTS, the Principles of an Art or Science.

ELEVATION, or upright of a Building, &c. a geometrical Draught of a Front, &c. expressing by a Scale of equal parts, the Measure of every part.——*Elevations*, how made, p. 162.

ELIPSIS, a geometrical Figure made by an oblique Section of a Cone, in whose Curve there is not any part of a Circle, and therefore cannot be an Oval, which is composed of four Arches of two Circles; as some Writers of Dictionaries have said it to be.

——— how traced, p. 149, 345.

EMBRASURE, the Splay-back of a Window, or Door, within-side, made to give more Light, than when the Piers or Jaumbs are made square.

ENGLISH Order, p. 321.

ENNEAGON, the same as *Nonagon*, a regular Polygon of nine sides, p. 122.

ENRICHMENTS of Mouldings, &c. their Carvings, of which we have here a very great Variety, by almost every one of the Masters; but more particularly by *Julian Mauclerc*.

ENTABLATURE, or *Entablement*, p. 210.

Entablatures for Doors and Windows, p. 316.

ENTRESOLE, or *Entersole*, the same as *Mezanine*, a little Story between two grand Stories, as in the *New Treasury, Whitehall*.

ENTASIS, what, p. 210.

EPICTHEATES, p. 209.

EPISTYLUM, the same as *Architrave*.

EQUALITY of geometrical Figures, p. 405.

EQUAL parts, how divided, p. 135, 136.

EQUIANGULAR, when in a geometrical Figure, two or more of its Angles are equal to each other.

EQUICRURAL, a right-angled plain Triangle, whose Legs are equal.

EQUILATERAL, equal sided; hence it is, that a Triangle of three equal Sides is called an equilateral Triangle; hence also, a geometrical Square, and all regular, equal-sided Polygons, are equilateral Figures.

Equilateral Triangle, p. 120, 141.

——— to inscribe in a Square, 158. in a Pentagon, 159.

EQUILIBRIO, the exact equality of Weight, in a Ballance.

E S

ESTRADE, the eminent part of an Alcove in a Bed-chamber.

EURYTHMIA, the harmonious Proportions of Rooms, into which the Limits of a Plan is divided.

EUSTYLE, what, p. 238.

EXERGUM, the Space without the Figure of a Basse Relievo, of a Medal, &c. wherein the Name, Inscription or Date is placed.

EXTRACTION of Roots, is the finding of Numbers equally equal, that being multiplied into themselves, once, twice, &c. their Product shall be equal to a Number given. This will be understood by the two following Examples.

I. *To extract the Square Root.*

Let 45,1584 be a square Number given to find its Root, or if 'tis supposed to be a geometrical Square, as *a e g i*, Fig. B, Plate 466 containing as many Feet; to extract its Root, is to find the Length of a side, as *a e*, &c.

(1) Make a Table of Squares, with their Genitive equal Numbers, as far as the nine Digits, as follows.

					Sq Numb		*Roots.*
	1		1		1		1
	2		2		4		2
	3		3		6		3
	4		4		16	whose	4
Multiply	5	into	5	its Square	25	Square	5
	6		6	is ——	36	Root	6
	7		7		49	is	7
	8		8		64		8
	9		9		81		9

By this Table you find by Inspection, the Square in the 3d Column, and Root in the 4th of any single Number, composed or made up of any one of the Digits.

(2) Point every other Place of the given Number beginning with that of Units; and as many such Points that the given Number contains, so many Figures will the Root consist of, and on the Right-hand side make a Crotchet as *a b*, as is done in Division. This done, have recourse to the first Punctation, which is 45, and in the 3d Column of the above Table find the nearest less Number thereto, which is 36, whose Root is 6, as in the 4th Column. Place 36 under 45, and its Root 6, in the Quotient, as under A, and then subtracting 36 from 45, the Remains is 9. This is your first Work, and is no more to be repeated.

```
      .  .  . a ABC
   451,584(672
   36       b
   —
   9 remains
       . .
    D  915( first resolvend.
  12,7/889
     ———
  E— 26 remains.
```

(3) For Plainness sake place the 9 a Line lower, as at D, and to it bring down the next Punctation 15, making it 915, which is the first Resolvend

```
F 134,2)26,84 (2d resol-
        26,84   vend.
        ——
        0000  remains
```

or

or Dividend, and make a Crotchet on the Left-hand ſide as in Diviſion.

(4) Double the Root 6, it makes 12, which is a Diviſor; reject 5, the laſt Figure of the Reſolvend, and then, dividing the other Figures (91) by 12, the Quotient is 7, which place in the Quotient under B, and to follow the Diviſor 12 alſo, making it 12,7: This done, multiply 127 the Diviſor encreaſed by 7 (the Root placed under B in the Quotient) and placing the Product (889) under the Dividend (915), ſubtract it from thence, and the Remainder will be 26, as at E.

(5) For Plainneſs ſake, place the Remainder 26 a Line lower, (as at F) and to it bring down the next and laſt punctation 84, making it 26,84, which is a ſecond Reſolvend, and make a Crotchet on the left Hand, as before.

(6) Double 67 the Root hitherto found, which makes 134 for a new Diviſor; reject 4 the laſt Figure of the ſecond Reſolvend, and then, dividing the other Figures (268) by 134, the Quotient will be 2, which place in the Quotient, as under C, and alſo to follow the Diviſor 134, making it 1342. This done multiply 1342, the Diviſor encreaſed, by 2, the Root laſt placed in the Quotient under C, and placing the product 2684 under the Dividend 2684, ſubtract it from thence, and nothing will remain, which ends the Operation, and gives 672 for the ſquare Root required.

Note, It ſometimes happens, that when an Extraction is thus ended, there are Figures remaining, which are called *Irrational Surds*, and the given ſquare Numbers, from whence they come, are called Irrational Numbers, or Squares whoſe Roots or ſides cannot be expreſſed numerically, neither by whole Numbers nor Fractions, there being always ſomething remaining; and ſuch Numbers are 3, 7, 19, &c.

☞ It is alſo to be obſerved, that when the Subtrahend happens to be greater than the Reſolvend, as in this ſecond Example, the Quotient, by which the Diviſor is multiplied, muſt be abated, until the Product produc'd thereby be equal to, or leſs than the Reſolvend.

```
      . .
      256(16
      —
      1 remains.

  2,7)156(firſt Reſolvend.
    7)189(Subtrahend.

A 2,6)156
    6)156
    ——
      000 remains.
```

In this Example the firſt punctation is 2, and the neareſt leſs Square thereto is 1, which I place under 2, and its Root 1 in the Quotient; then, ſubtracting 1 from 2, there remains 1, which I remove a Line lower to prevent Confuſion, and to it, bring down the next punctation, 56, making it 156 for a Reſolvend: This done, double the Quotient, which makes 2 for a Diviſor, and rejecting the laſt Figure of the Reſolvend, 6, I find the Remainder 15 to contain the Diviſor 7 times; therefore I place 7 after the Diviſor 2, making it 27, and multiply it by 7, the Product is 189, which is placed under the Reſolvend for a Subtrahend; but as this Subtrahend is greater than the Reſolvend, a new Subtrahend muſt be found, that will be equal to, or leſs than the Reſolvend, as aforeſaid.

To find this new Subtrahend, we muſt take the Diviſor 2 but 6 times (inſtead of 7 times) in 15, and place 6 after the Diviſor 2, as at A, making it 26, which being multiplied by 6, the Product is 156, which being equal to the Reſolvend, nothing remains. And in caſe that this new Subtrahend had yet been greater than the Reſolvend, the Diviſor 2 muſt have been taken but 5 or 4, &c. times in 15; and ſuch Number of times as is found to produce a proper Subtrahend, ſuch Number muſt be placed in the Quotient, as herein, 6 is placed for the Quotient; which completes the Root as required.

II. *To extract the Cube Root.*

Let 146,363,183 be a cubical Number given, to find its ſide or Root:

(1) Make a Table of Cubes, with their Genitive equal Numbers, as far as the nine Digits, as follows.

Multiply	Roots.	into		its Square is	Squares.	which being multiplied again into		its Product is	Cubes.	which is the Cube of	
	1		1		1		1		1		1
	2		2		4		2		8		2
	3		3		9		3		27		3
	4		4		16		4		64		4
	5		5		25		5		125		5
	6		6		36		6		216		6
	7		7		49		7		343		7
	8		8		64		8		512		8
	9		9		81		9		729		9

(2) Set a Point over the place of Units in the Cube Number given; omit two, and point every third, and as many ſuch Points that the given Number contains, ſo many Figures will the Root conſiſt of.

(3) In the above Table of Cubes find the greateſt Cube that is neareſt to 146, the firſt punctation, which is 125, whoſe Root is 5, as ſtands in the firſt Column of the Table againſt 125; place the Root 5 in the Quotient under A, as is done in Diviſion, and its Cube Number 125 under (146) the firſt punctation, and then ſubtracting 125 from 146, the Remainder is 21; this is your firſt Work, and is no more to be repeated.

(4) To 21 the Remainder annex, or bring down 363, the ſecond punctation, which together make 21,363 for the firſt Reſolvend, as at C.

(5) Square the Quotient 5, and triple its Product 25, the Product is 75, which is a Diviſor, by which the Reſolvend (its two laſt Figures 6 3 excepted) is to be divided; that is to ſay, the Figures 2 1 3, as at B, wherein the Diviſor 75 being found twice, and 63 remains, therefore place 2 to follow 5, as under D.

(6) Treble the Root 5, it makes 15, which multiplied by 4, the Square of the Quotient B, makes 60; alſo cube the Quotient 2, which is 8; bring down 150, the product of the Diviſor 75 multiplied

```
     .   .   . A D I
    146,363,183(527
    125
    ——
     21

      C, firſt Reſolvend.
    21,363
       B
  75)213(2
     150
     ——
       63 remains.

E   150 .
F     60
G      8
   ———
  15,608
   ———
    5755 remains.

    H, ſecond Reſolvend.
  5,755,183
  ————

        K
8112)57,551(7
     56,784
     ————
        767

     .     L
   56,784 .
O    7644 .
P     343
   ————
  5,755,183
```

multiplied into the Quotient 2, as at E, and under it place the 60 and the 8 last found, each a place backwarder from each other, as at F and G; these three Numbers added together make a Subtrahend 15,608, which must be subtracted from the Resolvend C, 21,363, and the Remainder will be 5755.

(7) To these Remains 5755 annex or bring down 183, the next (and last) punctation of the given cubed Number, which together make 5,755,183, as at H, and is a second, or new Resolvend with which proceed, as with C the first Resolvend, in manner following, *viz.*

AB

(1) Square the Quotient 52, it makes 2704, which trebled, or multiplied by 3, makes 8112, which is a Divisor, by which the second Resolvend 5,755,183 (its last two Figures 8 3 excepted) is to be divided, *viz.* the Figures 57,551, as at K.

(2) Divide 57,551 by 8112 (as at K) the Quotient is 7, which also place following 52, as under I, and 767 will remain.

D

AB

(3) Treble the Quotient 52, it makes 156, which, multiplied by (49) the Square of 7 the Quotient K, makes 7644. Also cube the Quotient 7, it makes 343; bring down 56,784, the Product of the Divisor 8112 multiplied into the Quotient 7, as at L, and under it place the 7644, and the 343 last found, each a place backwarder towards the right Hand, as at O and P. These three Numbers added together make a Subtrahend 5,755,183, which being subtracted from H the 2d Resolvend, 5,755,183, nothing remains;

ADI

wherefore the Figures 527 are the Cube Root required.

Note, I. As many Periods as you have, except the 1st, so often this last Work is to be repeated.

II. That in all Extractions, when a Divisor cannot be found so often as once in its Dividend, or if it can be found, and yet there should arise a Subtrahend greater than the Resolvend, in both these Cases a Cypher must be put in the Quotient, and annexed to the last Divisor also, for a new Divisor, and then the next Punctation being brought down and added to the last Resolvend for a new Resolvend, proceed in every particular as aforesaid.

III. When Numbers remain after the last Subtraction is made, which oftentimes happen, such are called Irrational or Surd Numbers, because their Roots cannot be exactly expressed by Numerical Figures, altho' by adding of Cyphers, we can come very near the Truth.

EXTERNAL ANGLES, p. 166.

EXCESS, what, p. 99.

EXOTICK Pedestal, Pl. 295.

EXTREAM and *Mean Proportion*, is, when a Line is so divided, that the whole is to the greater Segment, as the greater Segment is to the less.

EXTREAMS, what, p. 87.

EYE-DRAUGHT, what, p. 173.

———how made, p. 173.

F.

F, IN Latin Numerals, stands for 40, with a Dash thus, F̄ 4000

FACIA, *Fascia*, or *Fasce*, *vide* p. 210.

FASTIGIUM, the upper angular Point of a Pediment.

FATHOM, what, p. 16.

FESTOON, from *Festus*, Inrichments of Wreaths, that were anciently made of Fruits, Flowers, &c. on Festival Occasions; and which are now made in carved Wood, Stone, &c. for the Embellishments of Buildings, as in the Freeze of the Portico of St. *Mary* the *Ægyptian*, Pl. 112.

FEET in Length in a Yard,
———Fathom,
———Statue Pole or Perch,
———Chains Length or Acres Breadth,
———Rood, Furlong, or Acres Length, } p. 16.
———Mile,
———League,
———Degree,
———Circumference of the Earth,

——— square { In a square Yard,
Square of 10 Feet,
In a square Rod,
In an Acre of Land, } p. 16.

FIGURE, geometrical, a Superficies terminated by one or more Lines, as a Circle by one, a Semicircle by two, a Triangle by three, &c.

Figures right-lined, or rectilineal, are those whose Limits consist of Right-lines only, as plain Triangles, geometrical Squares, Parallelograms, &c. which are called plain Figures.

Curvilineal Figures, are such that are bounded by Curved-lines, as Circles, Ovals, Ellipses, &c.

Mixed Figures, are such that are bounded with Right-lines and Curved-lines also.

Regular Figures, are such whose opposite sides and opposite Angles are equal.

Irregular Figures, are those whose sides and Angles are unequal.

FINAL, what, p. 187, 206.

A FINAL in Sculpture, an Inrichment on a Tomb or Funeral Monument, representing the end of Mortal Life, as a Lamp extinguished; or a Boy holding in his Hand an extinguished Torch, fixed on a Death's Head at his Feet.

FINISHING of a Building, to cover the Outwalls with Lime and Drift-sand, so as to resemble or imitate *Portland-stone*, which by some is called *rough cast*.

FLOORING, how framed, p. 353.

FLUTES, or *Flutings* of Pilasters, and Columns.

———By *Vitruvius*, p. 235, 238. pl. 53, 54.

———*Palladio*, p. 239. pl. 59, 60.

To represent on Paper the geometrical View of fluted Columns and Pilasters, *vide* Pl. R, following Plate 50, wherein Inspection shews, that having divided the Semi-plan of the Column into its Flutes only, as Fig. I. or into its Flutes and Filets, as in Fig. III. and Right-lines drawn from the several Divisions in each Base, at right Angles to the Diameters, they thereby determine the Breadth of the Appearance of each Flute and Fillet. The Pilaster, Fig. II. having its Diameter divided into 31 equal parts, give one to the Bead at each Angle, three to each Flute, and one to each Fillet. A Pilaster thus fluted, with Beads at the Angles, is most proper for the *Corinthian* Order.

Draw

To divide at once the Flutes and Fillets on the Shaft of an *Ionick* or *Corinthian* Column, this is the *Rule*:——

Draw a right Line on Paper, *&c.* as *a b*, in the lower Figure, and therein prick off with two pair of Compaſſes (the one being opened to one 3d of the other) 24 Flutes, and as many Fillets, of any Size at Pleaſure; ſo that the whole 24 of each, from *a* to *b*, be ſomething leſs than the Girt of the Column, in that part where you want to divide out the Flutes and Fillets. This done, from the ſeveral Diviſions in the Line *a b*, draw right Lines at right Angles to *a b*, of Length at Pleaſure; and then having taken the exact Girt of the Shaft with a piece of Parchment, *&c.* that hath one ſtreight Edge, apply the Ends thereof ſo as to touch the two outer Lines, as the piece *d e*; then will the ſeveral parallel Lines cut the Edge thereof, in the Points 1, 2, 3, 4, *&c.* which are the true Breadths of every Flute and Fillet required; and then the Parchment being applied about the Shaft, the Breadth of each Flute and Fillet may be moſt readily ſet off with great Exactneſs.

In the ſame Manner the Breadths of the Flutes and Fillets may be determined in every other part of the Column's Height at Pleaſure.

FOCUS-*Points* of an Ellipſis, two points in the longeſt Diameter, whoſe Diſtance from the Ends of the ſhorteſt Diameter, are always equal to half the longeſt Diameter, as *d h*, (Fig. 60, Plate 5.) on which every Ellipſis may be deſcribed. *Vide Ellipſis*.

FODDER of Lead, what, p. 17.

FOLIAGE, Inrichments of Branches, Leaves, and Fruits, repreſented by Carving, Painting, or Plaſtering, as in Plate 416.

FOOT in Length 12 Inches } *vide* Tables I,
——*ſquare* 144 ſq. Inches, } II, p. 16.
——*cubical or ſolid*, 1728 cubical Inches.

FRACTION, what, p. 71.

Fractional Parts, what, p. 17.
——*Architecture*, p. 324.

FRAMING of Partitions, p. 357.
——of Floors, p. 353.
——of Roofs, p. 362.

FREEZE, *Frize*, or *Frieſe*, by the *Italians* called *Fregio*, *vide* p. 187, 209.

FRENCH *Order*, p. 318.

FRETT, Ornament of the Ancients, p. 329.

FRIGERATORY, a Place wherein the Air is always very cool, as a *Grotto*, *Cave*, &c.

FRONTISPIECE, what, p. 242.

Frontiſpieces { *Tuſcan*, } p. 334.
{ *Dorick*, }
{ *Ionick*, p. 266, 279, 334.
{ *Corinthian*, p. 290, 291, 334.
{ *Compoſite*, p. 307, 330, 335.

FRONTON, the ſame as *Pediment*, and therefore a ſmall Pediment over a Door or Window, is called a *Frontal*.

FUST, what, p. 187.

G In Latin Numbers ſignifies 400, with a Daſh thus, Ḡ 40,000.

GALLICK *Order*, the (ſame as) *French Order*.

GALLERY, a Long-room for walking, danceing, *&c.* whoſe Breadth in grand Buildings, ſhould

never be leſs than 20 Feet; and Length not leſs than 4, nor more than 8 Times its Breadth.

Gallery at *Belvedere*, p. 309.

GATE of *Farneſe*, p. 242.

Gates by *Michael Angelo*, p. 330.

GENERATE, to beget, or produce.

GENERATING-*Line*, or *Figure*, that which by its Motion produces any other Figure or Body; it is the ſame as *Deſcribent*.

GEOMETRICAL, that which is dependent on right or curved Lines, or formed thereby, therefore all Things, that have Form, being bounded by Lines, are conſequently *geometrical*.

GEOMETRICAL *Square*, p. 121.
——how generated, p. 142.
——how deſcribed, p. 143.
——from whence originally taken, p. 220.
——its Diagonals and Diameters, what, p. 121.
——how inſcribed within any Triangle, p. 158; within a Pentagon, p. 159.
——how circumſcribed about any Triangle, p. 161; about a Circle, p. 160.

GEOMETRY, the moſt noble and moſt uſeful Art in the World, on which all Trade and Arts depend; it is divided into *ſpeculative* and *practical*; the former demonſtrating the Properties of *Lines*, *Angles* and *Figures*; the latter how to apply them to Practice in *Architecture*, *Perſpective*, *Mechanicks*, *Trigonometry*, *Menſuration*, *Surveying*, *Dialling*, *Aſtronomy*, *Navigation*, &c In the Time of the building of the Temple of *Solomon*, HIRAM, the chief Architect of that Building, cauſed this noble Art to be taught, in all its various Branches, and ſuch Perſons, who by their natural Inclinations to Art, and cloſe Application to Study, became Proficients therein, were by him made free of Maſonry, or the Art of Building, and accepted for the Overſeers and Foremen of that magnificent Pile. Theſe Students in *Geometry*, being thus made free and accepted Maſons, were commanded by HIRAM not to reveal the Secrets, or Rules of *Geometry*, but to ſuch who were Builders, and would undertake to be ſtudious therein, and which they were commanded to teach *gratis*, in a brotherly Manner: Hence it was that the Fraternity of FREE and ACCEPTED MASONS had their Beginning; and ſuch are the Secrets of their noble Art, which, for the Satisfaction and Improvement of this cenſorious Age, are in this Work made publick.

GEOMETRICIAN, a Perſon ſkilful in *Geometry*.

GEOMETRICAL *Plan*, an exact Repreſentation of the Ground-plat of an intended, or real Building, Garden, *&c.* proportion'd, and drawn by a Scale of equal parts, repreſenting Feet, Yards, *&c.* by which every part of the Plan may be very correctly meaſured. It is alſo called *Ichnography*; the *Greeks* named it *Veſtigii Deſcriptio*, or rather *Veſtigium Operis*, the ſuperficial Efformation of the future Work.

Geometrical Elevation, called alſo *Orthography*, the Upright, or Front of a Building, repreſented by a Scale of equal parts, in the ſame manner as the *geometrical Plan*, expreſſing the juſt Proportion of every Window, Door, *&c.* contained therein.

GOCCIOLATOIO, vide *Corona*.

GOLA, vide *Cima*.

G O

GOLDEN *Rule*, what,
———how performed, } p. 87.
———*Direct*,
———the Rule, p. 88.
———*Indirect*, what, p. 92.
———*Compound*, p. 95.

GORGE, the Freeze or Neck of the *Tuſcan* and *Dorick* Capitals, as 1, Fig. A, Plate 100; the ſame as *Hypotrachelium*.

GOTHICK *Arches*, how deſcribed, } 338.
———their Kinds,
———*Pitch* of Roofs, p. 360.

GIRDERS, or *Girding-beams*, how placed in Buildings, p. 353.
———how cut *camber*, p. 355.
———their Scantlings, p. 354.
———how truſs'd, p. 355,—364.

GRADETTI, or *Gradetto*, the ſame as *Annulet*.

GROTESQUE *Order*, p. 319.

GROUPE of Statues, or Columns, when there are three or more placed together on one Pedeſtal.

GROINS of Arches, how found, p. 377, 378.

GRUPPA, a Cluſter of *Figures*, *Heads*, *Flowers*, &c. placed ſo cloſe together, that no one entire can be ſeen.

GUILLOCHES, or *Guilochi's*, the ſame as *Fretts*.

GULA, *Gola*, or *Geule*, *recta* and *reverſa*, the ſame as *Cima recta* and *reverſa*.

GUTTA, p. 233, plate 50.

H

H, WITH a Daſh over it (thus, H) did in ancient Times denote 200,000.

HALF-Pace of a Stair-caſe, p. 384.

HANCES, or *Hanches* of an Arch, what, p. 352.

HAND-*Rail* to a Stair-caſe, p. 384.

HAMMER-*Beam*, what, p. 367, 370.

HARMONY *of Parts*, an Exactitude of the Diſpoſition and Proportion of the parts, into which the geometrical Plan, or Elevation of a Building is divided. *Vide Symmetry*.

HARMONICAL *Diviſion of a Line* is, when the whole Length is to one Extream, as the other Extream is to the intermediate part.

HEADERS, *Stretchers* and *Cloſers* in Brickwork, *vide* Fig. 2, Plate 369, where *a a* are Headers, *n n* Stretchers, and *c c* Cloſers.

HEIGHT, the third Dimenſion of a Solid, with reſpect to its Elevation above its Baſe.

Height of a geometrical Figure, is a Perpendicular, drawn from its higheſt part unto its Baſe, as *b d*, Fig. 13, Plate 1.

HELIXES, or *Urilla's*, the ſmall Volutes of the *Corinthian* Capital, which are moſt beautiful, when twin'd into each other, as in Pl. 186.

HENDECAGON, a regular Polygon of eleven equal Sides, and as many equal Angles; it is alſo called *Undecagon*.

HEPTAGON, p. 122.
———how generated, p. 142.
———how deſcribed, p. 151.

HEXAEDRON, a regular Solid or Cube, of ſix equal Faces.

HEXAGON, p. 122.
———how generated, p. 142.

HEXASTYLE, a Portico conſiſting of ſix Columns, which is alſo called *Pycnoſtyle*, as in Pl. 187.

H I

HIP-*Rafters*, what, p. 363.
———their Lengths how found, *ibid.*
———how backed, p. 364, 366, 371, 372.
———Curved, how found, p. 373, 374.
——— ——— how backed, p. 373.

HORIZONTAL-*Line*, that which is truly level.

HYPÆTHRON, an ancient Temple without a Roof or Covering.

HYPERTHYRON, *Greek*, a Table placed in the Architrave and Freeze of an Order, for an Inſcription, as in Plate 266, (where the Name of *Serlio* is placed) it alſo ſignifies the *King-piece*, which the *Italians* call *Soppra frontale*.

HYPETHRE, a double Range of Columns about a Temple, as in Plate 188.

HYPOTHENUSE *of a Triangle*, p. 121.

HYPOTRACHELIUM, what, p. 210.

I

I, Numerically ſignifies 1.

JACK-*Arch*, a ſtreight Arch of Brick over the Head of a Window, which is but one Brick's Length in Height.

JACK-*Rafters*, the ſhort Rafters in the end of a hipp'd Roof.

ICHNOGRAPHY, the geometrical Plan of a Building, &c.

ICOSAEDRON, one of the five regular Solids, terminated by twenty equilateral Triangles.

JET *d' Eau*, the aſcending Stream of Water of a Fountain.

IMPOSTS, what, Fig. 1, p. 30.

INACCESSIBLE *Height* or *Diſtance*, that which cannot be approached to be meaſured, &c.
———*Buildings*, how plann'd, p. 172.

INCH, a Length equal to the Length of 3 Barley-corns laid together in a right Line, p. 16.

INCRUSTATION, the facing of a Wall, Column, &c. with Stone, Marble, &c.

INDEFINITE, unlimited, or boundleſs.

INFINITE, that Line, &c. which hath no Bounds aſſigned to it.

INSCRIBING Figures, what, p. 157.

INSCRIPTIONS, how written by the *Romans*, vide that on the Column of *Trajan*, p. 224.

INSERTED *Columns*, Plate 354.

INTEGER, what, p. 17.

INTERCOLUMNATION, p. 238.

INTERLACINGS, what, p. 329.

INTER-*Tie*, what, p. 358.

INTERNAL *Angles*, what, p. 166.

INTERSECTION *of Lines*, the cutting of one Line by another, as *a d* by *g h*, Fig. 14, Pl. 1.

JOGGLE *of a King-poſt*, p. 364.

JOISTS, their Kinds, p. 355.
———their Lengths, p. 356.

IONICK *Order*, by *Carlo Ceſare Oſio*, p. 255, to 261.
——— in the Theatre of *Marcellus*, p. 262, 263.
——— in the Temple of *Manly Fortune*, ibid.
——— in the Bath of *Diocleſian*, } p. 264.
——— by *Vitruvius*,
———*Palladio*, p. 265.
———*Scamozzi*, p. 266.
——— *Barozzio*, p. 267.
———*Serlio*, p. 268.
———*Le Clerc*, p. 270.
———*Cataneo*,
———*Barbaro*, } p. 271.
———*Viola*,
———*L. B. Alberti*,

Ionick Order by *P. de Lorme*,
——*Bullant*, p. 271.
——*Perault*,
——*J. Mau-clerc*, p. 272.
——*Inigo Jones*,
——Sir *Christopher Wren*, p. 274.
——Mr. *John Gibbs*, p. 275.
IRON *Gates*, p. 330.
IRREGULAR *Buildings*, how plann'd, p. 168.
IRREGULAR *Curves*, how plann'd, *ibid.*
ISOCELES *Triangle*, what, p. 120.
——how generated, p. 141.
——how described, p. 143.

K

K, Numerically represents 250, and anciently, with a Dash, (thus, K̄) it signified 150,000.

KEY-*Stone of an Arch*, the uppermost *Voussoir*, as *s i*, Fig. C, Plate 357.

KING-*Post*, what, p. 356, 360.

KNEE *of a Hand-rail* to a Stair-case, the Angle made in its bottom, by the level part meeting the raking part, as the Angle at *k*, Fig. 3, pl. 440.

L

L, IN *Latin* Numbers signifies 50, with a Dash (thus, L̄) 50,000.

LACUNAR, an arched Cieling.

LANTHERN, or *Turret*, an Ornament placed on a Dome, &c. as that on Fig. A, pl. 391, which is nothing more, than a small Dome supported by little Columns, either absolute of themselves, or with Imposts and Arches between them, and which are made entirely open, or glaz'd, as Occasions require.

LARMIER, the same as *Corona*.

LATERAL, of, or belonging to the sides of a Figure ; hence a Triangle, whose sides are all *equi*, that is to say, equal, is called *equilateral*.

LANDS *Irregular*, how plann'd, p. 174, to 179.

LATHS, their Length, and Number to a Bundle, p. 17.

LEAGUE, what,
Leagues in a Mile, p. 16.
——in Circumference of the Earth,

LEGS of a right-angled Triangle, what, p. 121.

LEMMA, a Proposition preparatory for the Demonstration of a *Theorem*, or Construction of a *Problem*.

LENGTH, the first kind of Dimensions of Superficies and Solids.

LETTERS, *Capitals* for Inscriptions ; their Height must be regulated according to their Number, which is required to be in a given Length, and which may be thus found, *viz.* Number the Letters in the Words, and thereto add as many ones less one, as are Words in a Line ; divide the Length into as many equal parts, as the Sum of the Letters and the ones less one, and make the Height of the Letters equal to one of those equal parts ; then each Letter will possess a geometrical Square, and the ones added, as aforesaid, will give the Interval between each Word equal to a geometrical Square also: When the Spaces for the Letters are thus determined, proceed to make them, as taught in Pl. 461, &c.

If 'tis required to proportion the Height of a Letter standing high, as at *g*, Fig. A, pl. 466, to appear at *a* equal in Height to another Letter, as *e d*, which is much lower, proceed as follows: From *a*, the given Point of View, draw the Lines *a d*, *a e* and *a g*, and on *a*, with any Radius, describe an Arch, as *i h k l*; make *k l* equal to *i h*, and through *l* draw the Line *a l f*, cutting the upright Line *c f* in *f*, then will the Height *f g* be the Height of the Letter required ; for as the Angle *l a k* is equal to the Angle *h a i*, therefore they are both seen under equal Angles, and consequently their Heights will appear equal also. In the same manner, the Height of Statues required to stand on Buildings, may be found to appear equal to the Height of a Man on the Ground, from any given Point of View.

LINE, what, p. 112.
——the Kinds,
LIST, *Listello*, what, p. 187, 206.
LINKS in a Chain, p. 33.
LINTELS, their Scantlings, p. 353.
——their Length,
LOAD of Timber,
——Earth,
——Bricks,
——Sand, p. 17
——Lime,
——Plank,

LUTHERN-*Windows*, the same as *Dormant*, or *Dormer-windows*, such as stand on the Rafters of a Roof ; they are called *Dormer*, or *Dormant-windows* from the Word *Dormitory*, a Sleeping-place, to which Use the Rooms enlightned by these Windows are generally applied.

M

M, Numerically signifies 1000, and with a Dash (thus, M̄) 1,000,000.

MAGNITUDE, a certain Quantity of Matter or Space, possessed by a geometrical Figure, or solid Body ; that is, the Bigness of every geometrical Figure or Superficies, as also every solid Body, is called *Magnitude*, and therefore equal Things are of equal Magnitudes ; but when two Things of the same Kind are, one greater, or lesser than the other, as a Man and a Boy, then they are said to be of different Magnitudes, that is, the Man is of greater Magnitude than the Boy, and the Boy of lesser Magnitude than the Man.

MANNERS *of Building* are three, *viz.* the *Solid*, the *Mean*, and the *Delicate*, which are well expressed by the *Dorick*, *Ionick*, and *Corinthian* Orders.

MASONRY, the Art of preparing, forming and putting together the various Materials of which Buildings are made, such as Stone, Bricks, Timber, Tiles, Lead, Iron, &c. which, to well perform, requires an extensive Knowledge in *Arithmetick*, *Geometry*, and *Architecture*, and therefore no Person can be a perfect good Mason, who is unacquainted therewith. Hence 'tis plain, that the Art of Masonry is not the Art of hewing and squaring of Stones only, which is the Business of a Stone-cutter, but comprizes the *Manuaris*, or Work of the Carpenter, of the Bricklayer, of the Joiner, and, in short, of every other Artificer employed in the raising and finishing of Buildings in general ; for without the Carpenter's, Bricklayer's, Joiner's, &c. Works, that of the Stone-cutter is useless, and therefore these last are as much Masons as the first, because all of their Works

M E

Works depend on each other, and together do but compleat a Building.

MEANS, or *middle Terms*, what, p. 87.

MEASURES *of Length*, what, p. 16.

MEMBERS, what, p. 187.

MEMBRETTI, p. 236.

MENTUM, vide *Corona*.

METOCHE, the Interval, or Diftance between two Dentils, as the Intervals 26 5, 8 11, in Pl. 167.

METOPE, what, p. 258.

MEZZANINE, vulgarly called *Mizzana*, p. 383.

MILE, what, p. 16.

Miles in a League, } p. 16.
——— Degree,
——— Circumference of the Earth,

MINUTES in a Degree, p. 115.

——— in a Module, p. 202.

MITRE *of an Angle*, a Right-line dividing a folid Angle into two equal parts.

MIX [illegible] formed by a Right-line [illegible], Pl. 1.

Mix'd Number, what, p. 17.

MO[illegible] a Pattern made of Wood, or any other Material in Miniature by a fmall Scale, wherein every part is fo proportion'd, as the Building is to be which 'tis made to reprefent, and which gives a much better Idea of large Buildings, to many Perfons, than geometrical Plans and Elevations can do.

MODULE, or *Modulus*, of a Column, what, p. 202.

——— how found, p. 203, 205.

MODILLION, from the *Italian*, *Modiglioni*, a plain Support to the Corona of the *Corinthian* and *Compofite* Cornices, as C, Plate 166. In *Latin* a Modillion is called *Mutuli*, from whence the fquare Modillions in the *Dorick* Order, whofe Sofits are enriched with Bells or Drops, are called *Mutules*, and which are always of much lefs Depth than the Modillions in the *Corinthian* Order. When the Modillions of the *Corinthian* Order are enriched with Scrolls carved on their fides, and Leaves on their Sofits, they are called [illegible], are therefore called *Cantalivers Cornices*, as in Pl. 1[illegible].

MONOPTERE, a Dome fupported by Columns inftead of Walls, as in Plate 191.

MONUMENT of *London*, p. 249.

——— a Column, Statue, Urn, &c. erected to perpetuate the Memory of a Perfon or Action.

MOSAICK *Pavement*, or rather *Mufaick* Work, from the *Mufea* of the *Greeks*, a kind of Pavement compofed of very fmall Pieces of Marble, Stone, Glafs, &c. which are fo placed, as to reprefent Flowers, Figures, Animals, &c. Vide Plate 449.

MOULDINGS, fingle and compound, p. 187.

——— for Pannels or Picture-frames, p. 317.

MORTISES, their Proportions, p. 365.

MULTANGULAR, a geometrical Figure or Body of many Angles.

MULTILATERAL, a geometrical Figure of many fides.

MULTINOMINAL, that has many Names.

MULTIPLICATION, what, p. 47.

——— geometrically demonftrated, p. 412.

——— Table, p. 50.

——— of Integers, p. 51, to 54.

M U

Multiplication by a new Method, p. 56.

——— of Integers and Fractions, p. 412.

——— of Pence and Farthings, p. 57.

——— of Pounds, Shillings and Pence, p. 58.

——— of Feet and Inches, p. 59.

——— of Feet, Inches and Parts, p. 61, 413.

MULTIPLICAND, } what, p. 47.
MULTIPLIER,

MUNIONS, *Montins*, or *Mortans*, upright Pofts, that divide the feveral Lights in a Window-frame, as thofe two in the *Vitruvian* Window, pl. 340.

MUTULE, vide *Modillion*.

N

N IN *Latin* Numbers fignifies 900, with [illegible]

NAKED, of a Column or Wall, the upright, or out-fide Face thereof.

NET-*Mafonry*, called *Reticulation*, from its Refemblance of a Net, Walls built with fquare Stones, whofe Diagonals are, one parallel, and the other perpendicular to the Horizon.

NEWEL-*Poft*, the upright Poft, about which a circular, or ellip[illegible] p. 384, 389.

NICHES, what, p. 333.

——— their Formation, p. 347.

——— femicircular, } [illegible]
——— [illegible]

——— to make their Centers, p. 350.

——— how formed out of Thickneffes of Planks, p. 351.

NONAGON, [illegible] p. 122.

——— how generated, p. 142.

——— how defcribed, p. 151.

NUDITIES, thofe parts of a human Figure not covered with Drapery.

NUMBER *of Places*, what, p. 100.

NUMBERS, how expreffed, p. 11.

NUMERATION, what, p. 12.

——— geometrically demonftrated, p. 409.

——— Tables, p. 12, 14.

NUMERATOR *of a Fraction*, what, p. 71.

NUMERICAL *Figures* for Clocks, Pl. 467.

O

O, Numerically was ufed by the Ancients to denote 11, and with a Dafh (thus, o) 11,000,000.

OBELISK, or *Obelifque*, a Memorial Pillar without Capitals, p. 327.

OBLIQUE-*Angle*, any right-lined Angle, that is not right-angled.

OBLONG, what, p. 123.

OBTUSE-*Angle*, what, p. 117.

OCCULT *Lines*, dotted Lines, as the ferpentine Line C, Plate 1.

OCTAGON, what, p. 122.

OCTAHEDRON, one of the five regular Bodies, confifting of eight equilateral Triangles.

OCTOSTYLE, a Portico confifting of eight Columns, as in pl. 187.

OGEE, vide *Cima*.

OPPOSITE *Angles*, thofe that are againft each other, as the Angle *a b e* is oppofite to the Angle *f b b*, Fig. 5, pl. 2.

ORDER, in Architecture, what, p. 187.

——— its parts, *ibid*.

ORDERS, the Kinds are, the *Grotefque*, the *Tufcan*, the *Dorick*, the *Ionick*, the *Corinthian*, the

the *Compoſite*, the *Cariatides*, the *Perſian*, the *French*, the *Spaniſh*, the *Gothick*, and the *Engliſh*, being twelve in Number.

———how delineated, p. 206.

ORDINATES, Right-lines drawn at Right-angles from the Diameter of a Circle, or an Ellipſis, as the Lines * 1, * 2, * 3, in Fig. 4, Pl. 370, which are perpendicular to the Diameter *p k q*, and terminate at the Circumference of the Circle in the Points *, *, *, &c.

ORDONANCE, the Art of proportioning the ſeveral Rooms, &c. into which a Plan of a Building is divided.

ORNAMENT, vide *Entablature*; *Ornaments* of Mouldings are, *Leaves*, *Foliages*, *Flutings*, *Chaplets*, *Roſes*, &c. of which in the following Maſters (but more particularly in the Orders of *Julian Mau-clerc*) is a very great Variety; from whence the ingenious Student may invent others without Limitation.

ORTHOGRAPHY *of a Building*, is a geometrical Elevation of the Front of a Building, repreſenting the exact Proportions of every part, into which the Whole is divided, ſuch as the Door, Windows, &c. and this is called the *external Orthography*. The *internal Orthography* is that, which Workmen call the *Section* of a Building, which is a geometrical Elevation alſo, expreſſing the Height of each Story, Breadth of Rooms, Thickneſſes of End-walls, Partitions, &c. ſuppoſing the Front to be removed away from before them.

OVALS, how deſcribed, p. 208.

———how enriched, p. 209.

OVOLO, what, p. 187, 209.

OXYGONIUM-*Triangle*, what, p. 121.

P

PALLIFICATION, the ſtrengthening, or making a bad Foundation good, by means of ſingle, or dove-tail'd Piles of Oak, &c. driven into the Ground. To do this effectually, 'tis beſt to drive a Line of dove-tail'd Piles all round the Limits of a Foundation, before any inward Piles are driven, becauſe they confine the encloſed Earth, and cauſe it to be very compact and firm, when the inward Piles are driven.

PARALLEL-*Lines*, what, p. 134.

———how drawn, p. 134, 135.

PARALLELOGRAM, what, p. 123.

———how generated, p. 142.

———how deſcribed, p. 143.

PARAPET-*Wall*, from the *Italian*, *Parpetto*, a Save-breaſt, or Wall placed above the Cornice of a Houſe, to hide a part of the Roof, and oftentimes to add a Height to the Front alſo.

PARASTATÆ, p. 236.

PARSLEY-*Leaves*, p. 287.

PARTITIONS, how framed, p. 357.

PATER-*Noſters*, the little Beads carved in an Aſtragal, as in I, the *Ionick* Capital, pl. 164.

PAVEMENTS, p. 395, pl. 449, 450, &c.

PAVING-*Bricks*, p. 85.

PAVING-*Tiles*, the Number to a Thouſand, p. 86.

PEDESTAL, what, p. 187, 211.

———their Heights, how determined, p. 188.

———*Dorick* by *C. C. Oſio*, p. 227.

———circular, how worked, p. 347.

PEDAMENT, or *Pediment*, in *French Fronton*, from the *Latin Frons*, the Forehead, was anciently the Gable-ends of the Roof of a Temple, circumſcribed with the ſame Cornice, that the ſubjacent Order was of, which the Ancients named *Tympanum*, and its uppermoſt Angle *Faſtigium*. In ancient Times, Dwelling-houſes were made with flat Coverings, and (as *Salmaſius* tells us in *Solin*) *Julius Cæſar* was the firſt, whom the ancient *Romans* indulged with a Pediment to a Dwelling-houſe, his Palace being raiſed in this *faſtigious* Manner.

Pediment, *Pitch*, what, p. 360.

———Raking, } what, p. 333
——— Circular, }

———its Center, to find arithmetically, as follows: Let *d a c*, Fig. 4, Plate A, following Plate 369, be a given Pediment, whoſe Breadth *d c* is 22 feet, and Height *b a*, 6 feet.

RULE.

Multiply half the Breadth into itſelf, (*viz.* 11 into 11) the Product is 121, which divide by the Height, (6 feet) the Quotient is 20 and $\frac{1}{6}$, which add to 6, the given Height, the Sum is 26 $\frac{1}{6}$; half of which, being placed on the Line *a b*, continued from *a* to *e*, will give the Point *e* for the Center required.

Pediments, their Mitres with level Cornices are found as follows, Plate 312.

Let d c b be a part of the level Cornice, that is, let d b be its Height, and d c its Projection; from the Points c, a, b, draw Right-lines to repreſent the Raking-lines of a Pediment riſing from the level Cornice, alſo draw the Line a b, which divide into two equal parts; divide each part into any Number of equal parts, and draw Ordinates to the Curves of the *Cima*; aſſign a Point in the Line k b at pleaſure, as at e, from whence draw the Line e f at Right-angles to l c; make g f and h d, each equal to d c the Projection of the level Cornice, and draw the Line h e, which divide into two parts at r; divide each of theſe parts into the ſame Number of equal parts, as each half of a b is divided into, and from thence draw Ordinates, (correſpondently equal to thoſe of a b) and through their Extreams trace the Curve or Face of the *Raking Cima*, as required.

Pediments, *open*, their returned Cornices are found as follows: From the angular Point of Return, as *l*, draw an horizontal Line, as *l i*, which make equal to d c, the Projection of the level Cornice; from the Points *l* and *i* let fall two Perpendiculars l m and i k, and draw the Line m k, which divide into the ſame Number of equal parts, as a b, and making thoſe Ordinates alſo equal to the Ordinates of a b, through their Extreams trace the Curve of the returned Cornice, as required. By this laſt Method, not only the different Curvatures of the *Cima Inverſa*, with which Modillions are generally *caped*, may be found, as the Figures *u* and *w* expreſs, whoſe common Mould is Figure *t*, but all other kinds of Mouldings alſo

PENTAGON, what, p. 122.

———to inſcribe in an equilateral Triangle, p. 159.

———to circumſcribe about a Circle, p. 160.

——— ———about a geometrical Square. p. 161.

PENTEDECAGON, what, and how inſcribed in a Circle, p. 159.

PERIMETER, or *Periphery*, the Circumference of a Circle, Square, &c.

PERCH, or *Pole*, what, p. 16

P E

PERIPTERE, a Temple environ'd with a single or double Range of Columns.

PERISTYLE, a Temple, *&c.* with a Colonade about its Inside, as in Plate 188.

PERPENDICULAR, what, p. 18.
——how erected, p. 127, to 131.
——how to let fall, p. 132, 133.

PERSIAN *Order*, p. 326.

PHRYGIO, vide *Freeze.*

PIAZZA, in *Italian Piache*, an arched Walk with arched Apertures on one or both of its sides, divided by square Piers, or Pillars, (not Columns) which are generally rusticated, as Plate 41.

PIEDOUCHE, a little Pedestal, on which a Busto is placed, as that under the Busto in Plate 431.

PIERS, or *Piedroits*, for Gates to Palaces, *&c.* p. 330, to 333.

PILASTER, a square Column.
——its Projection, } p. 236.
——how fluted, }
——*Composite* by *Vitruvius*, p. 332.
——of Stone, how built, p. 328.

PILLARS, *Latin*, *Pila*, Supports to the Groins of a Vault, having nothing more than square Blocks for their Bases, and the like for their Capitals, from whence the Arches spring; they are not restrained to any certain Height or Diameter, otherwise than will best suit the place and purpose they are employed in.

PINNACLE, a square or octangular Pyramid, crown'd with a Pine-apple, *&c.* and its Hips or Angles enriched with Husks of Flowers, Leaves, *&c.* which are generally placed on the Angles of a Tower, with Balustrades between them; they are also called *Acroteres.*

PITCH *of a Roof*, the Kinds, p. 360.
——for Lead, Slate, Pan-tile, and Plain-tile, p. 361.

PLANS, geometrical how made, p. 162.

PLANCHIER, *Plancere*, or *Planceer*, the under part, or Cieling of the *Corona* of a Cornice, p. 209.

PLANE, or *Plane Figure*, a plane Superficies, or Surface, whose parts in general lie even between its Extremities, without any Risings or Hollows therein, but perfectly, evenly smooth.

PLANETTI, what, p. 257.

PLAT-*Band*, what, p. 187.

PLATONICK *Bodies*, the five regular Bodies that may be inscribed within a Sphere, *viz.* the *Tetrahedron*, the *Hexahedron*, or *Cube*, the *Octahedron*, the *Dodecahedron*, and the *Icosahedron.*

PLINTH, *Italian Plinto*, what, p. 187, 206.

POINT, what, p. 112.

POLE, or *Perch*, Statute-measure, what, p. 16.
Poles, or *Rods*, in a Chain's Length, }
——in an Acre's Breadth, }
——in a Mile, } *ibid.*
——in a League, }
——in a Degree, }
——in the Circumference of the Earth, }

POLYGONS, what, p. 122.
——of all Kinds, how made, p. 152.
——how inscribed, p. 160.
——how circumscribed, p. 155.

PORTICO, anciently a Porch formed by Columns, supporting a part of the Roof of a Building, continued out beyond the Upright of its End; but now-a-days they are oftentimes placed before the Front of Buildings, supporting a pediment, *&c.*

P O

POSTULATES, self-evident *Propositions.*

PRICK-*Posts*, vide Fig. 5, pl. 374.

PRINCIPLES *of an Art*, the first Grounds and Rules, on which the practice depends, and by which it is performed.

PRINCIPAL *Posts*, their Scantlings, p. 359.
——*Rafters*, their Scantling and Framing, p. 360, to 365.

PROBLEM, what, p. 99.

PRODUCT, what, p. 48.

PROFILE, the Out-line, or Contour of the Front of a Building, *&c.* viewed directly against an End.

PROGRESSION, p. 98.

PROJECTION *of Members*, how accounted, p. 207.

PROJECTURE, or *Projection of Members*, is their sailing over, or out-jetting beyond the Upright of a Wall, or Freeze of a Column, which the *Greeks* call *Ecphoras*, and the *Italians*, *Sporti.*

PROMINENT, jetting out, or standing forward.

PROPORTION *Architectonical*, is the Relation, which the parts of a Building, that are considered together, have to one another.
——*Arithmetical*, is when divers Numbers have an equal Difference, as 2, 4, 10, 14, 18, &c. whose Excess is 4.
——*Geometrical*, when divers Numbers differ according to a like Ratio, *viz.* As 2 is to 5, so is 4 to 10, &c.
——*Extream* and *Mean*, p. 397.

PROPORTIONAL *Lines*, 397, 399.

PROPORTIONALS, what, p. 87.

PROPORTIONAL *Scales*, for the ready delineating any of the five Orders in Architecture according to any Master, are made as follows:

Draw a Right-line, as A B, pl. B, to follow pl. 17, which divide according to the proportions of any Order, (suppose the *Tuscan*;) continue out its Base K L at pleasure, as to the point L, from whence draw Right-lines to every of the Members on the Line A K; from K towards L set off any Number of Divisions, equal or unequal, as at the points 34, 33, 32, &c. and from thence drawing Right-lines parallel to A K, every of them will be divided by the Lines drawn from L, in the same proportion as the Line A K.

Suppose 'tis required to delineate, or proportion the *Tuscan* Order to the Height of the line *a l*; draw a Right-line parallel to K L, at the Distance of the length of the given line, which will cut the line A L in *a*, from which point drawing *a l* parallel to A K, it will be divided in the same proportion as A K, *viz.* *a b* will be the Height of its Cornice, *b c* of its Freeze, *c d* of its Architrave, *d e* of its Capital, *e g* of its Shaft, *g h* of its Base, *h i* of its Cornice to its Pedestal, *i k* of its Dado, (or Die) and *k l* of the Pedestal's Base; and so in like manner each Member of every such principal part. The Heights of every Member being thus found, transfer them on your Drawing, and through every one draw Right-lines at pleasure parallel to its Base.

To determine their Projectures, make the Scale, Fig. 1, as follows: Draw the line T V, and thereon set the Cornice, the Architrave, the Capital, the Astragal, the Base, and the Cornice and Base of the Pedestal, each from the central line of the Order,

P R

Order, and at any Diſtance from each other; this done, continue Y T to S, making S T equal to K L; let fall Perpendiculars from the projection of every Member on the line T V, as at the points *a*, *s*, *t*, *v*, *w*, *x*, *b*, *c*, &c. and from thence draw Right-lines to S; make T W equal to K *l*, and from W draw the line W X parallel to T V; then will 6 7 be the projection of the Cornice, 25 9 of the Architrave, 23 11 of the Capital, 24 13 of the Aſtragal, 16 17 of the Baſe, 19 20 of the Cornice to the Pedeſtal, and 22 X of the Baſe to the Pedeſtal; and ſo in like manner each Member of every ſuch principal part. The Projections of each Member being thus found, transfer them on your Drawing, and through their Extreams trace their Out-lines, which will compleat the Whole, as required. From hence we may proportion an Order to any given Height, and find the Heights of its parts in Feet and Inches.

Suppoſe 'tis required to proportion the *Tuſcan* Order entire to 20 Feet Height: The Order being deſcribed, as at A K, divide its Height into 20 equal parts, repreſenting Feet, and each part into 12, repreſenting Inches; then, by drawing parallel lines from every principal, or particular Member unto the Scale of Feet and Inches, you immediately ſee how many Feet and Inches, or Inches and parts are contained in every ſuch Member. In the ſame manner any part of an Order, as a Pedeſtal, a Column, an Entablature, or a Cornice, may be proportioned to any given Height, which a little Inſpection, and mature Conſideration will plainly demonſtrate.

PROPOSITION, a Problem, or Theorem propoſed to be demonſtrated or proved.

PROTHYRIS, *Greek*, a Quoin, or Angle of a Wall.

PROTHYRUM, a portal, or porch before the Door of a Houſe.

PROTRACTER, a Semicircle of Braſs, whoſe Limb is divided into 180 Degrees, for the ready meaſuring, or laying down any Angle required. *Vide* p. 129, 130.

PULVINATA, a ſwelling Freeze, as P, pl. 156.

PUNCTUM, a Point.

PUNCTATION *of a ſquare Number*, is every two Figures, and the laſt one alſo, when it happens, being pointed and accounted from the Right-hand to the Left, as thus, 172543217. *Punctation of a Cube Number* is every three Figures, as thus, 12479724385.

PURLINS, their Scantlings, p. 361.

———how framed, p. 367.

PYCNOSTYLOS, p. 238.

PYRAMID, from the *Greek*, *Pyr*, Fire or Flame, with reſpect to its being a Solid which terminates in a point, as Flame is ſaid to do.

A *Pyramid*, or *Pyramis*, is that Solid which is commonly called a *Spire*, having a Triangle, a Square, or a polygon for its Baſe, and its Altitude at pleaſure.

Q

Q, Anciently repreſented 500, as D now doth, and with a Daſh ($\overline{Q}$) 500,000.

Q. E. D. ſignifies *Quod erat demonſtrandum*, that is to ſay, *Which was to be demonſtrated.*

QUADRANGLE, or *Quadrate*, the ſame as *geometrical Square.*

Q U

QUADRANT *of a Circle*, what, p. 126.

QUADRILATERAL *Figures*, thoſe that are of four ſides, either regular or irregular.

QUARTER-*Pace* of a Stair-caſe, what, p. 385.

QUIN-*Decagon*, the ſame as *Pendecagon*, a polygon of 15 ſides.

QUINQUE-*Angled*, five angled.

QUOIN, a ſolid Angle, as of a Building, &c which are often ruſticated, as in pl. 263.

QUOTIENT, what, p. 66.

R

R, Signified among the Ancients 80, and with a Daſh (thus, $\overline{R}$) 80,000

RADIUS, what, p. 116, 119.

———equal to 60 Degrees, p. 129.

RAFTERS, how framed, p. 364.

———their Scantlings, p. 362.

———their Kinds are three, *viz. Principal Rafters*, *Hip-rafters*, and *Jack-rafters.*

RAILS *to Stair-caſes*, how knee'd and ramped, p. 396.

———*Twiſted*, how ſquared, p. 388, to 393.

———on a circular Baſe, p. 389.

RAMP *of a Rail to a Stair-caſe*, its Height how found, p. 387.

———its Center and point of Contact may be found as follows: Suppoſe *o n*, Fig. 1, pl. A, following pl. 369, to be the raking part of a Hand-rail, and *w i* its Ramp, to find its Center *k*, and point of Contact *w*. On any point, as *q*, taken at pleaſure, in the line *h i* continued deſcribe the Arch *i r o*; let fall the perpendicular *q r* on *o w*, and continued to *r*; draw the line *i r* cutting the Raking-rail in *w*, from whence draw *w k* parallel to *q r*; then is *k* the Center of the Ramp, and *w* the point of Contact, from whence the Arch or Ramp proceeds.—— For this general Method I am obliged to Mr. HENRY MAXTED of *Canterbury*, who was ſo kind as to communicate it to me, for the publick Good of Workmen that are employed in ſuch Works.

RAISING-*Plates*, how ſcarfed together, p. 359, 360.

RAKING-*Cornice* of a Pediment, pl. 345.

RANK *of Numbers*, what, p. 98.

RATIO, the Rate, or proportion which ſeveral Quantities have to one another, that is, as 3 is to 7, ſo is 12 to 28; now here the *Ratio*, or proportion of 12 to 28 is as 3 is to 7; and ſo the like of any other Quantities.

RECTANGLE, the ſame as a *Right-angle.*

RECTANGLED, the ſame as *Right-angled.*

RECTILINEAL, the ſame as *Right-lin'd.*

REDUCTION, a Rule in Arithmetick, teaching how to reduce Money, Weights, Meaſures, &c. into the ſame Value in other Denominations.

Reduction is two-fold, *viz. Aſcending* or *Deſcending.*

Reduction Aſcending, is to reduce a lower Denomination into a higher, as Farthings into pence, Inches into Feet, &c. vide p. 62, to 64.

Reduction Deſcending, is to reduce a higher Denomination into a lower, as pounds into Shillings, Feet into Inches, &c. vide p. 75, to 85.

Reduction of geometrical Figures, p. 401.

REGULA, the uppermoſt Fillet, that finiſhes a Cornice, or Capital, as A R E, Fig. 2, pl. 24.

REGLET, or *Riglet*, the flat, ſquare Liſt, or Fillet, with which the ancient Fret Ornament, &c.

R E

&c. is made.

REGULAR *Body*, vide *Platonick Bodies*.

RELIEVO, *Italian*, the Projecture of emboffed Work, as Figures of Men, Beafts, *&c.* above the Plane on which they are reprefented, fuch as the Heads on Money, Medals, *&c.* which rife above the Surface. There are three Kinds of *Relievo*, viz. 1. *Baffo-relievo*, low Relief, as of Money, Medals, *&c.* 2. *Mezzo-relievo*, called by fome *Demi-relievo*, that is to fay, *Half-relief*, when one half of the natural Thicknefs is prominent. 3. *Alto-relievo*, High-relief, when the Figures are more than half prominent, and not quite clear from the Plane.

REMARKS on *Vitruvius*, p. 208.

———on *Palladio* and *Scamozzi*, p. 211.

———on *Barozzio* and *Mau-clerc*, p. 212, 214.

———on *Le Clerc*, p. 214, 215.

RESOLVEND, a Number in the Extraction of the fquare and Cube Root, arifing from the Remainder being encreafed by the next Punctation being brought down and annexed thereto. Vide *Extraction of Roots*.

RHOMBUS, what, p. 123.

———how generated, p. 142.

———how defcribed, p. 144.

RHOMBOIDES, what, p. 123.

———how generated, p. 142.

———how defcribed, p. 144.

RIGHT-*Angle*, what, p. 117.

RIGHT-*Angled Triangle*, what, p. 120.

RIGHT-*Line*, what, p. 113.

Right-lines, how continued. p. 139.

ROD, in length 16 Feet, 6 Inches, the fame as *Statute-pole*.

———*fquare*, 272 fquare Feet ¼.

Rods fquare in a fquare Chain, }
———in an Acre of Land, } p. 16.

ROOD, in length, what, }
Roods in a Mile, }
———in a League, } *ibid.*
———in the Circumf. of the Earth, }

———*fuperficial*, one 4th of an Acre, or 40 fquare Rods, *ibid.*

ROOFS, Regular, }
Irregular, } how delineated, p. 365.

———Curved, how framed, p. 368.

———Hemifpherical, how framed, p. 369.

———Triangular, }
———Bevel, } demonftrated, p. 371.
———Irregular, }

———Curved, how covered with Lead, *&c.* p. 374.

ROOMS, their Proportions, p. 375.

ROTUNDA, or *Monoptere*, by *Vitruvius*, p. 255.

ROOT *fquare*, a Number, which being multiplied into itfelf is equal to a fquare Number given; or 'tis the Side of a geometrical Square, whofe Area is given: So likewife the Cube Root is the Side of a Cube, whofe Solidity is given. *Vide Extraction of Roots*.

ROTATION, the Circumvolution of a Surface round an immoveable line, as a Semicircle on its Diameter, which generates a Sphere; a Semi-ellipfis about its longeft Diameter, which generates a Spheroid; a right-angled Triangle about one of its Sides, which generates a Cone; a Parallelogram about one of its Sides, which generates a Cylinder, *&c.*

R U

RUDIMENTS, the firft Principles of an Art or Science.

RULE *of Proportion*, or *Rule of Three*, p. 87.

RUSTICKS, large fquared Blocks of Stone, which the Ancients employed in the Quoins of their Brick Buildings, for the more effectual binding thofe parts (which are as Nerves) together, as in pl. 263; wherein obferve, that the longeft are called *Stretching Rufticks*, and the fhorteft *Heading Rufticks*. The ancient Way of forming the Edges of Rufticks was, to chamfer them off 45 Degrees back, as in Fig. 1, 2, pl. 45, whereby their Angles became obtufe and ftrong, fo as not to be injured at their fetting, *&c.* which a fquare Angle is more liable to. It was alfo a Practice among the Ancients to build their moft beautiful Fronts rufticated in this Manner, leaving the Out-faces of each Stone rough, as it came out of the Quarry, until the whole Height was raifed, when they began at the Top, and worked down a fmooth Face, cutting away all the prominent parts of the ruftick Stones in fo exact and neat a Manner, that the Joints were fcarcely perceptible. *Rabbit*, or *fquare Rufticks*, as in pl. 263, is a *modern Mode* contrary to their original Ufe, their Angles being fquare, and liable to Injuries, which the others are not.

RUSTICATED Gates, p. 242.

———Columns, p. 220.

———Doors, p. 46, 227.

———Quoins, p. 226.

S

S, Among the Ancients denoted the Number 7.

SAFFITA, vide *Sofito*.

SCABELLUM, in ancient Architecture, a Pedeftal to fupport a *Bufto* or *Relievo*, the fame as [illegible].

SCALENUM-*Triangle*, what, p. 120.

SCAMILI *Impares*, Zocco's, or fquare Blocks, placed under an Order, or Statue, to elevate it to a proper Height; in fhort, they are nothing more, than two or more Plinths on one another in manner of Steps, of greater Projections, than the Plinth of the Order or Statue they fupport. The feveral fquared diminifhed Zocco's, that form the pyramidical Top of St. *George*, *Bloomsbury*, on which the Statue of K. George I. is placed, are *Scamili impares*.

SCALE *of equal Parts*, how made, }
———its Ufe, } p. 124.

———of Feet and Inches, *ibid.*

———its Ufe, p. 125.

———of Chords, how made, p. 129.

SCAPUS, vide *Shaft*.

To SCARF Timber together, p. 359.

SCENOGRAPHY, the Art of reprefenting perfpective Appearances of *Plans*, *Elevaions*, &c.

SCHEME-*Arch*, Fig. D, E, F, pl. 355.

Scheme of a femicircular Arch, what, p. 352.

SCHOLIUM, a Remark, or Comment on a Propofition before demonftrated.

SCIAGRAPHY, the Art of drawing the elevated parts within a Building, (fuppofing the Whole to be cut down thro' its length or Breadth) fhewing the Infide of every Room, Thicknefs of Floors, Walls, *&c.* which is therefore commonly called the *Section*.

SCIMATUM, vide *Cyma*.

SCOTIA, p. 237.

Scotia,

S C

Scotia, how deſcribed by *Alberti*, p. 49, 230.
SCROLLS for twiſted Rails, how deſcribed, p. 387.
SECTION of a Building, *vide Sciagraphy*.
SECTOR of a Circle, what, p. 119.
SEGMENT, *Latin*, a Piece.
———of a Circle, *vide* Def. 23, p. 119.
SEMI, *Latin*, Half.
SEMIDIAMETER of a Circle, what, p. 116, 119.
SEPTAGON, a Polygon of ſeven Sides, the ſame as *Heptagon*.
———how generated, p. 142.
———how deſcribed, p. 151.
SERPENTINE *River*, how plann'd, p. 180.
SHAFT, what, p. 187, 210.
SIMILAR, of a like Nature.
Similar Figures, p. 400.
SKETCH, a rough Draught of a Deſign, made in a ſlight Manner, by Hand, without Rule or Compaſſes.
SKEW-*Back* of Arches over Windows, *&c.* the Quantity that the upper Angle (as *a*, Fig. C, pl. 355) recedes, or falls from the Upright of *c*, that is, if the Line of the Side of a Window be continued up to the upper Line of its Arch, the Diſtance from that Line to the outer Angle, as to *a*, is the Quantity of the Skew-back, and which is made more or leſs, according to the placing of the Center of the Arch, which the ſeveral Examples in plate 355 demonſtrate.
SOCLE, or *Sub-baſe*, p. 211.
SOFFITA, *Soffito, Saffita, Soffit, Sopheta*, or *Sophete*, from *Subfixum*, a kind of Cieling, by which the Cielings of Windows are underſtood.
Soffita of a circular Window, how ornamented, p. 381, 382.
———of circular Windows, how found, p. 346, 347.
SOLID *Angle*, the Meeting of three or more Planes in a point.
SOLIDITY, the ſolid Content of a Body.
SOLUTION, an Anſwer to a Problem or Queſtion.
SOMMERING *Courſes* of an Arch in Brick or Stone, thoſe which point directly to its Center.
SPANISH *Order*, p. 317.
SPHERE, a Globe or Ball, *vide Rotation*.
SPHEROID, vide *Rotation*.
SPIRAL *Line*, how deſcribed, p. 156.
SPIRES, their Proportions and Framing, p. 368.
SQUARE-*Root*, vide *Extraction of Roots*.
———*Angle*, an Angle containing 90 Degrees.
———*Meaſure*,
———*Foot*,
———*Yard*,
———of 10 Feet, p. 15
———*Rod*,
———*Chain*,
———*Inches* in a ſquare Foot, p. 37.
———*Feet* in a ſquare Rod,
———*Poles* in a ſquare Rod, p. 36.
———*Roods* in an Acre,
STAIRS *circular*, p. 383.
STAIR-*Caſe, cylindrical*, p. 391.
———*circular*, p. 383.
———*mixt*, p. 384.
———a Plan, how deſcribed, *ibid.*
———a Section, how raiſed,
———*Dog-legg'd*, and *right-angled*, p. 385.

S T

STEEPLE, a Building erected at the Weſt-end of a Church for the Conveniency of hanging Bells therein, and for Ornament alſo; when 'tis finiſhed with a Pyramis, 'tis called a *Spire*, and when without, as with Battlements, *&c.* 'tis called a *Tower*.
STEREOBATE, or *Stylobates*, vide *Pedeſtal*, p. 211.
STRETCHERS, vide *Headers*.
STRIÆ, or *Striges*, vide *Flutings*.
STRUTS, their Scantlings, p. 360.
———how framed, p. 364.
SUBTRACTION, what, p. 39.
———geometrically demonſtrated, p. 411.
———how proved, p. 40.
———how performed, p. 39, to 46.
SUBTRAHEND, the leſſer Number in *Subtraction*, that is ſubtracted out of the greater.
SUMMIT, the Top, Vertex, or upper Point of a Triangle, Pyrament, or Faſtigium of a Pediment.
SUPERCILIUM, vide *Corona*.
SUPERFICIES, the Surface of a Solid, which is conſidered to have Length and Breadth (as a Shadow) without Thickneſs.
SUPERFICIAL *Figure*, what, p. 122.
SUPERSTRUCT, *Latin*, to build one Thing upon another, as a
SUPERSTRUCTURE, the upper parts of a Building raiſed on the lower.
SUPPLEMENT *of an Arch*, the Number of Degrees that it is leſs than 180, which is ſometimes called its *Complement* to 180 Degrees.
SYMMETRY, the Harmony, Proportion, or Uniformity of parts, that runs between the parts of a Building and the Whole.
SYSTYLE, or *Syſtylos*, p. 238.

T

T, Anciently denoted 160, and with a Daſh (thus $\bar{\text{T}}$) 160,000.
TABLES *for Inſcriptions* are ſquare or oblong planes, placed againſt Walls, alſo in the Architrave and Freeze of an Entablature.
TALLIOR, *French*, a plain, ſquare Abacus to the *Tuſcan* Capital, as E, pl. 17, Fig. 147.
TALON, vide *Aſtragal*.
TAMBOUR, the *Vaſe, Drum*, or *Bell* of a *Corinthian* or *Compoſite* Capital.
TAXIS, with the Ancients was the ſame as *Ordonance* is with the Moderns.
TEMPLE, *Dorick* by *Bramante*, p. 77, 244.
———*Ionick* by *Barozzio*, *Serlio*, p. 292. *Vitruvius*, p. 265.
———of *Jupiter*, p. 288.
———*Corinthian* by *Vitruvius*, ibid.
TENIA, p. 210.
TENONS *of principal Rafters*, p. 365.
TERMS *geometrical*, are Points, Lines, and Superficies; *viz.* (1) Points are the Terms or Ends of Lines; (2) Lines are the Terms or Bounds of Superficies; and (3) Superficies are the Terms or Limits of ſolid Bodies.
TE-*Square*, p. 131.
TESSELATED *Pavement*, a rich pavement of ſmall ſquares, in manner of pl. 449.
TETRAHEDRON, one of the five regular Bodies, comprehended under four equal and equilateral Triangles.

T H

THEOREM, p. 99.
THEORY, the Study of an Art or Science, exclusive of the Practice.
THERMÆ, a Hot-bath.
THESIS, a Subject to be discoursed upon: Also a Sentence, or Proposition advanced to be cleared by Demonstration.
TIMBERS in a Building, how to be situated, p. 366.
TONDINO, vide *Astragal.*
TON Weight, what, p. 16.
TORUS, what, p. 206.
TOWER, vide *Steeple.*
TOWN, how plann'd, p. 180.
TRABEATION, the same as Entablature.
TRABS, *Latin*, a Beam.
TRACTRIX, vide *Catanaria.*
TRAJAN's *Column*, p. 213, 215, 224.
TRAMMEL, what, p. 346.
TRANSFORMATION of geometrical Figures, p. 401.
TRAPEZIA, what, p. 122.
——— H[illegible], p. 144.
TRIANGLE equilateral,
——— Isosceles,
——— [illegible],
——— right angled, } p. [illegible]
——— Ambligonium,
——— Oxygonium, } p. 121.
TRIGLYPH, what, 237.
TRIMMERS, or Trimming Joysts, *vide* Fig. A, Plate 372, p. 356.
TRISECT, to divide a Line into three equal Parts.
TRIUMPHAL *Arches*, p. 307, to 309.
TROCHILUS, what, p. 237.
TROPHIES, Representations of Drums, Pikes, Halberds, and other Instruments of War.
TRUNK or *Tige*, the same as *Shaft.*
TRUSSES for Roofs, p. 362, to 367.
——— *Ionick*, p. 280, 329.
TUN, a Measure of Capacity in Liquids, equal to 252 Gallons.
TUSCAN-*Order* by the Ancients, p. 188, to 199.
——— by *Vitruvius*, p. 202.
——— by *Palladio*, p. 209.
——— by *Scamozzi*, p. 211.
——— by [illegible], p. 212.
——— by *Julian Mau-clerc*, p. 213.
——— by *Sebastian le Clerc*, p. 214.
——— by *Claude Perault*, p. 215.
——— by Mr. *John Gibbs*, p. 216.
——— by *S. Serlio*,
——— by Mr. *Stone*, } p. 218.
——— by Sir *Christopher Wren*, p. 220.
Tuscan Portico, p. 221.
TUSK, a Bevel Shoulder made on the Tnon of a Joyst to strengthen its bearing.
TWISTED *Rail*, how squared, p. 388, 393.
——— their Formation, p. 391, 392.
TWISTED *Columns*, vide Wreathed Columns.
TYMPAN of a Pediment, the Inward Triangular upright Part, that stands perpendicular over the Freeze.

V

V, In *Latin* Numbers stands for Five, and with a Dash (thus v̄) for 5000.
VAGINA, *Latin*, a Sheath, the lower part of a *Terminus*, which rises as out of a Sheath.

V A

VALLEY of a Roof, the external Concave Angle, made by the meeting of two Roofs.
VASES, Vessels that were used by the Ancients in their Sacrifices, in Imitation of which, solid Ornaments are made in form of Flower-pots, with ornamental Covers, enriched with curious Mouldings, and sometimes the Convexity of the Vase with Bass-reliefs; for adorning Piers to Gates, Parapet-walls, &c.
VANES of Weather-cocks, their Heights and Lengths, how found, p. 368.
VAULT with Groins, how plann'd, p. 181.
VELOCITY, the Degree of Swiftness, that a Body goes with, in passing through a certain Space, in a certain Time.
VENTALE, vide *Corona.*
VENETIAN Windows, p. 279.
VERTEX, the top or uppermost Point.
VERTUOSO, *Italian*, a curious and ingenious Person, delighting in collecting Rarities in Art and Nature.
VISTA, or *Visto, Italian*, a streight Opening made through a Hill, Wood, &c. to admit a distant View, being seen from a House, &c.
VIVO, *vide* Shaft.
VITRUVIAN *Window*, p. 332.
Vitruvian Scroll, p. 329.
UNDECAGON, what, p. 122.
——— how described, p. 152.
UNGULA, a Section, or a Segment of an Ellipsis, whose outer ordinate cuts the longest Diameter at Right angles.
UNITE, what, p. 12.
VOLUTE, or *Voluta*, vide p. 256, to 260.
VOUSSOIR, *French* a Stone of an Arch, whose Sides have a direct Sommering to its Center, and its Bottom a part of its Curve.
UPRIGHT, *geometrical*, of a Building, the same as the geometrical Elevation.
URN, *Latin*, *Urna*, a Vessel wherein the Ancients deposited the Ashes of their deceased Friends. It is no other than a covered Vase, representing Flame issuing out at its Vertex, and is generally used as a crowning or finishing of a Monument, &c.

W

WEATHER-*Cocks*, their Heights and Ornaments, p. 368.
WINDOWS, p. 333.
——— Rusticated,
——— *Venetian*, } p. 340.
——— Scheme-headed,
——— Semicircular,
——— Semi-elliptical, } in circular Walls, p. [illegible]
Windows in a Dome, circular or elliptical, are called *Lucar Windows*, and sometimes *Lacunars*, as those are in an arched Roof, or coved Ceiling. Vide *Lacunar.*
WREATHED *Columns*, p. 327.

X

X, IN Numbers signifies 10, and with a Dash (thus x̄) 10,000.
XYSTOS, a *Grecian* Portico of more than common Length, which were sometimes uncovered or open, wherein the *Athleta* exercised themselves in *Racing*, *Wrestling*, &c. The Word is *Greek*, signifying to polish, or make smooth; it being their Custom to anoint their

Bodies

Bodies with Oil before their Encounters, to prevent their Antagonists from laying fast hold of their Flesh.

The *Romans* had their *Xystos* also, which was a very long Portico arched over, with Plantations of Trees on each Side, forming an agreeable Place to walk in, in very hot or wet Weather.

Y

YARDS in a Fathom,
——in a Statute Pole or Perch,
——in a Chain's Length,
——in a Acre's Breadth, } p. 16.
Yards in a Rood, Furlong or Acre's Length, } p. 16.
Yards in a Mile,
——Circumference of the Earth. } p. 16.
Yard square, what,
Yards square in a Square of 10 Feet,
——in a square Rod,
——in a square Chain,
——in an Acre of Land, } p. 16.

Z

Z, WAS an ancient Numeral, and signified 2000; and with a Dash (thus Z̄) 2000 Times 2000.

ZOCCOLO, vide *Plinth*, p. 213.

ZOPHORUS, vide *Freeze*, p. 209.

ADVER-

Advertisement to the READER.

THE Reader is desired to observe, that this WORK was proposed to the Publick for to be performed by a SOCIETY, (or Set of People) as set forth in the *Introduction,* who for that Purpose entered into Articles with me, and undertook to do very great Things herein; but upon future Examination, when those Parts were wanted, that they undertook to perform, in the Course of the WORK, none of them produced any Thing: So that (had not I, of myself, been able to carry on and finish the Whole, as well as the *Arithmetick,* and Part of the *Geometry* to that Time) I should have been a very great Sufferer in the Expences, that I had then been at, for Paper and Printing, and the World disappointed of the PERFORMANCE also.

Parliament-Stairs,
10 Sept. 1735.

B. LANGLEY.

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